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Redondo Beach, CA 90278

Engineering & Manufacturing Development (EMD) Phase
Acquisitions &Operations Contract

CAGE NO. 11982

National Polar-Orbiting Operational Environmental Satellite System (NPOESS) FT1394 System Interface Requirements Document

DATE: 3 February 2004

NO. D34471
REV. B

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Under
Contract No. F04701-02-C-0502

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SUPPLEMENTAL SIGNATURE PAGE FOR APPROVERS OUTSIDE OF MATRIX SYSTEM. (To be filed after cover page of document.)

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# Revision/Change Record	**For Document No. D34471**

Revision	Document Date	Revision/Change Description	Pages Affected
---	7-24-2003	New	All
A	11-7-2003	Extensive update, changes are documented in an Excel file as part of ECR SS-057	All
B	2-3-2004	Update to include BATC comments and NPP Appendix	5, 26-27, 35, 42-43, 51, 54-56, 61, 63-64, 70-71,100

Outstanding TBRs/TBDs

Item	Section	Section Title	Description	Assigned	Due Date
1	3.2.1.2.1 b	Initialization Time	When cycling cable power, the Network initialization shall wait ≥ 16 (TBR) milliseconds following application of cable power. [NM]	P. McShane & B. Oliver	
2	3.2.1.2.1.1	Time for Tree Identify	The maximum time for tree identify shall be less than 300 TBR milliseconds for a 16-node implementation. [NI]	P. McShane	
3	3.2.1.2.1.2	Time for Self Identify	Each node on the bus shall perform self-identification, per IEEE Standard 1394a-2000, within 16 TBR milliseconds of completion of its children self-identification. [NI]	P. McShane	
4	Table 3.2.2-1	Arbitration Priority	<table><tr><th>Priority TBR [a]</th><th>Host</th><th>1394 Physical Packet Size (quadlets) TBR</th></tr><tr><td>2</td><td>SCP</td><td>128</td></tr><tr><td>2</td><td>PSP</td><td>128</td></tr><tr><td>2</td><td>CMIS</td><td>128</td></tr><tr><td>2</td><td>CrIS</td><td>128</td></tr><tr><td>32</td><td>VIIRS</td><td>128</td></tr><tr><td>2</td><td>DSU</td><td>128</td></tr><tr><td>0</td><td>Spare</td><td>0</td></tr></table>	P. McShane	
5	3.2.3.2	Physical and Link Layers	The sending node delay from bus grant to start of transaction shall be less than 1.29 µs TBR microsecond. [Host]	P. McShane	
6	3.2.12.4	Driver Commands	Usage of IP Ping by the Network Manager shall allow for a minimum of 250 TBR milliseconds for response prior to a retry. [NM]	F. Spandorf	

[a] The priority_req field.

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1 SCOPE

This 1394 System IRD defines the system functional and performance requirements baseline for the fault tolerant 1394 bus (designated hereafter FT1394) interfaces between the National Polar-Orbiting Operational Environmental Satellite System (NPOESS) spacecraft and Hosts. This document is comprised of requirements, guidance and clarifications. Guidance and clarifications are in italics to ensure they are clearly distinguishable from requirements that must be verified. All of these constitute a formal part of the document with changes to any requiring formal approval. The Spacecraft Contractor and the Host Providers shall each meet their respective interface requirements as defined in this document.

This document is intended to cover all requirements and information related to the system application of FT1394 and CCSDS in combination for both Telecommands and telemetry. The document applies to all NPOESS 1394 related equipment. The intent is to avoid having Host contractors assuming the answers to any design decision. This document will be living to the extent that as questions from Host contractors arise, the answers will be documented here.

1.1 Introduction

This document is formatted using the DoD or Cisco 4 layer models for Networks. The requirements structure is broken into functional requirements and performance requirements within a system decomposition envelope.

This is the NPOESS systems requirements document for FT1394. The program will field several high performance Hosts that will significantly enhance and improve the gathering of atmospheric and environmental data from a space-based platform. These high performance Hosts generate significantly higher data rates than previously flown Hosts. The IEEE 1394a Serial Bus was chosen as one of the transport mechanisms for carrying data from the Hosts to the Data Handling Processor. This specification addresses the implementation of the FT1394 data bus interface between designated Hosts and the Spacecraft C&DH. It is based on the IEEE 1394 serial bus specification with modifications and tailoring, such as reliability and fault management that specifically address its use on spacecraft with long life mission goals. When used in conjunction with 1394 standards, it is intended to provide all system requirements and definitions necessary to perform a next level decomposition resulting in compatible design including the system, and, all hardware and software.

All FT1394 references in this system level document specifically refer to this fault tolerant version of IEEE STD 1394-1995 and IEEE STD 1394a-2000 specifications.

Following each requirement, in square [ ] brackets, is the responsible entity for implementing the requirement. Where [ ] are missing the requirement applies to each component of the satellite including instruments.

1.1.1 Document Overview

This document is intended to follow the DoD and Cisco 4 layer model. It covers the components of the FT1394 network and the users of that network. A **Host** is any user that connects to the FT1394 network. Each Host attaches to the FT1394 network via two Dual-Nodes, one primary and one redundant. Each Node is comprised of a tri-port. Each Dual-Node attaches to both A and B 1394 buses via the two tri-ports. The **Root Node** is a specific node that connects to the network. The **Network Manager** is the Host containing the Root Node. The Network Manager in combination with the Root Node performs the functions of managing the network and its fault tolerance. The **Network Manager** is the application layer initialization and the fault tolerance management of the 1394 network.

1.1.2 Compliance

Each Host contractor will obtain spacecraft contractor concurrence for any assumptions regarding FT1394 implementation or requirement assumptions or unclear interpretations.

The spacecraft contractor shall maintain this document to include this new information either as a new requirement or explanatory notes.

This document defines and specifies the NPOESS system requirements and first level allocations equivalent to a subsystem where the network is its own subsystem.

1.2 Identification

This document specifies the system functional and performance requirements for a high-speed data bus interfacing the spacecraft and Hosts based on the IEEE 1394a S100 Serial Data Bus specification.

2 APPLICABLE DOCUMENTS

In the event of conflict between FT1394 (this document), the IEEE Standard 1394-1995 and IEEE Standard 1394a-2000 specifications, the order of precedence shall be FT1394, IEEE Standard 1394a-2000, IEEE Standard 1394-1995, respectively.

In the event of conflict between FT1394 (this document) and any RFCs referenced herein, this document shall take precedence over the RFCs.

This document shall take precedence over the D31418 and any Host specific ICD.

Design Assumptions: Where these documents are not explicit enough to perform a portion of the system, hardware and software designs, the spacecraft contractor will be consulted.

Waivers, exceptions and deviations to this document will not be approved.

The spacecraft contractor shall be the mediator for any unclear, unspecified, or conflicting requirement.

2.1 Government Documents

The following documents of the exact issue shown form a part of this FT1394 IRD to the extent specified herein.

In the event of conflict between the documents referenced herein or other documents referencing this document and the contents of this specification, this document shall be considered a superseding requirement.

2.1.1 Specifications

None

2.1.2 Standard

MIL-STD-461E (Tailored)	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

2.2 Non-government Documents

The following documents of the exact issue shown form a part of this FT1394 IRD to the extent specified herein.

In the event of conflict between the documents referenced herein or other documents referencing this document and the contents of this specification, this document shall be considered a superseding requirement.

2.2.1 Specifications

D31418 (Latest)	General Instrument Interface Document (GIID) for National Polar-Orbiting Operational Environmental Satellite System (NPOESS)

D35853	APID, VCID and Data Path Document
D36381	1394 Technology Interface Requirement Document

2.2.2 Standards

IEEE Standard 1394-1995	IEEE Standard for a High Performance Serial Bus
IEEE Standard 1394a-2000	IEEE Standard for a High Performance Serial Bus - Amendment 1
ISO/IEC 13213:1994	Information Technology – Microprocessor Systems – Control and Status Registers (CSR) Architecture for Microcomputer Buses.
CCSDS 301.0-B-2	Consultative Committee for Space Data Systems (CCSDS) Recommendation for Time Code Formats, Blue Book, April 1990
CCSDS 701.0-B-2	Advanced Orbiting Systems, Networks and Data Links, Blue Book, November 1992
1394 OHCI Rel 1.0	1394 Open Host Controller Interface Specification (as implemented by National Semiconductor IP CS4210 LLC and CS4103 PHY Layer)
RFC-791	Internet Protocol, DARPA Internet Program Protocol Specification, September 1981
RFC-768	User Datagram Protocol, DARPA Internet Program Protocol Specification, August 1980
RFC-2734	IPv4 Over 1394, December 1999

2.3 Reference Documents

2.3.1 Specifications

None

2.4 Conventions

2.4.1 Bit Numbering

All multiple bit sequences shall count bits beginning with bit 0, the most significant bit (MSB). [Host]

2.4.2 Byte Structure

All data shall be based upon Bytes. [Host]

Bytes, comprised of eight (8) binary bits, shall be formatted as MSB (bit zero) first and shall be pictorially represented as shown in Figure 2.4.2-1 [Host]

Figure 2.4.2-1 Byte Representation							
Bit Zero MSB	1	2	3	4	5	6	Bit Seven LSB

2.4.3 Digital Data Format

Data formats shall be documented in the NPOESS ICD. [Host]

2.4.4 Byte Numbering Convention and Nomenclature

The transmission order of bits within a byte and the relative ordering of bytes within a word shall be submitted for transmission 'Big Endian[a]. [Host] *When applied to networking, this is called 'network byte order'.*

Bit 0 of an N-bit$_{(modulo\ 8bits)}$ value shall be the Most Significant Bit (MSB). [Host]

Bit N-1 of an N-bit$_{(modulo\ 8bits)}$ value shall be the least significant bit. [Host]

The Byte containing bits 0-7 shall be transmitted first, followed by the next sequential Byte until all Bytes are transmitted.

2.4.5 Bit Sequencing

For serial data, the most significant bit (MSB, i.e. bit zero) shall be sent first. [Host]

2.4.6 Data Segment Sequencing

For data segmentation, the segments shall be sent ordered most significant segment first. [Host]

2.4.7 Spare Bits

All "spare" bits within a CCSDS packet data should be permanently set to value "zero". [Host, SC, Gnd]

[a] Note also that 'Big Endian' byte ordering is NOT what some machines (notably the 80x86 class of machines) use internally.

3 REQUIREMENTS

3.1 System Concept

3.1.1 System Configuration

This section addresses the implementation of a high-speed serial bus to carry digital data between the Spacecraft C&DH systems and the onboard Hosts. Digital data from the C&DH system may be of the form of commands or memory uploads to the Hosts; digital data from the Hosts may be telemetry data, Host scientific data, and memory image dumps. The bus implementation is based on the IEEE 1394 serial bus specification (IEEE Standard 1394a-2000) with modifications and tailoring, required for reliability and fault management, that specifically address its use on a spacecraft with long life mission requirements.

The FT1394 network is comprised of two 1394 buses. Each 1394 bus is implemented as a physical ring. The physical ring is implemented as a spanning tree where compliance to 1394 acyclic structure is accomplished through IEEE Standard 1394a-2000 capabilities. What makes this usage of 1394 unique is its ability to transport high rates of data with minimal impacts on real time processes and its ability to self heal in the face of failures.

3.1.1.1 Bus Communication Functions

IRD1394S000100 The FT1394 bus shall communicate spacecraft to Host transfers consisting of real time commands - commands from the ground or generated on-board. [SC]

IRD1394S000110 The FT1394 bus shall communicate spacecraft to Host transfers consisting of spacecraft stored commands - commands stored by the spacecraft for later execution. [SC]

IRD1394S000120 The FT1394 bus shall communicate spacecraft to Host transfers consisting of memory loads - memory loads including Host stored command tables from either the ground or the spacecraft. Memory loads will arrive as whole CCSDS Packets even when the load is segmented. [SC]

IRD1394S000130 The FT1394 bus shall communicate time code data from the spacecraft to the Host. [SC]

IRD1394S000140 The FT1394 bus shall communicate Host to spacecraft transfers consisting of engineering data - support data required to meet specified science data processing performance. [Host]

IRD1394S000150 The FT1394 bus shall communicate Host to spacecraft transfers consisting of housekeeping data - data related to Host state of health. [Host]

IRD1394S000160 The FT1394 bus shall communicate Host to spacecraft transfers consisting of calibration data - data resulting from the Host's calibration and alignment. [Host]

IRD1394S000170 The FT1394 bus shall communicate Host to spacecraft transfers consisting of mission science data - data as defined by the Host related to observations. [Host]

IRD1394S000180 The FT1394 bus shall communicate Host to spacecraft transfers consisting of diagnostic data - data specifically generated to diagnose a suspected problem. [Host]

IRD1394S000190 The FT1394 bus shall communicate Host to spacecraft transfers consisting of dwell data - data produced by a commanded dwell mode to super-sample a specific subset of information. [Host]

IRD1394S000200 The FT1394 bus shall communicate Host to spacecraft transfers consisting of telemetry monitor data - minimum data set needed to be monitored by the spacecraft that require prescribed actions by the spacecraft. [Host]

IRD1394S000210 The FT1394 bus shall communicate Host to spacecraft transfers consisting of LEO&A data – reduced housekeeping data for Launch Early Orbit & Anomaly monitoring. [Host]

3.1.1.2 Data Rates

IRD1394S000250 The spacecraft shall be capable of transferring the combined peak data rates from all Hosts as defined by this document and their individual contracts. [SC]

3.1.2 Interface Configuration

IRD1394S000300 FT1394 Interface shall comply with the 1394 S100 serial bus as specified by the IEEE 1394-1995 and amended by the IEEE 1394a-2000 specifications as tailored by this specification except as detailed in D36381. [NI] *The exception allowed by this requirement does not except any performance or functional requirement specifically called out within this document.*

3.1.3 Topology

3.1.3.1 Physical Topology

IRD1394S000400 The physical topology for the NPOESS FT1394 network shall be two ring buses as shown in Figure 3.1.3-1. [SC]

3.1.3.2 Logical Topology

IRD1394S000450 The logical topology for the NPOESS FT1394 Serial Bus shall be a cyclic network with finite branches and extent having one path in each serial bus broken between two Nodes such that it is “acyclic” during normal operations. [SC] *This is a spanning tree. “Acyclic” means that closed loops are unsupported; tree structures or “broken ring” structures are allowed*.

IRD1394S000460 When the ring (physical topology) is broken in one place, it shall be done such that the cable power remains intact. [NM]

3.1.3.3 Nodes

IRD1394S000500 Each node on the bus shall be comprised of three ports as shown in Figure 3.1.3-2. [NI]

IRD1394S000510 Each port shall be comprised of terminators, transceivers, and logic circuitry. [NI]

IRD1394S000520 Each port shall implement the Port Suspend and Port Disable features to allow the FT1394 bus topology to be reconfigured. [NI]

IRD1394S000530 Active ports shall support the bus repeater function regardless of the power state or mode of their Host unit as long as cable power is present. [NI]

3.1.3.3.1 Network Manager

IRD1394S000600 The Network Manager shall always reside in the Root Node. [Host, SC]

IRD1394S000610 Only one Network Manager shall be active on the FT1394 network at a time. [SC]

IRD1394S000620 The active Network Manager shall manage both bus A and bus B. [NM]

3.1.3.3.2 Root Node

IRD1394S000700 There shall be two Root Node capable Hosts, one active and one inactive. [SC]

IRD1394S000710 Each Root Node capable Host shall contain two Root Nodes. [SC]

IRD1394S000720 Each Root Node shall be a Host and Network Manager. [SC]

IRD1394S000730 Both system Root Node capable Hosts shall be the Spacecraft Control Processor (SCP), one in the prime SCP and one in the redundant SCP. [SC]

IRD1394S000740 Root Node functionality shall be part of the FT1394 software driver. [Driver]

IRD1394S000750 The two prime and the two redundant Root Nodes shall be active on a mutually exclusive basis. [SC]

IRD1394S000760 The inactive Root Nodes shall be active Host nodes. [SC]

IRD1394S000770 All Root Nodes shall be simultaneously powered (hot-backup). [SC]

3.1.3.3.3 Host Nodes

Host nodes are all nodes that connect to the 1394 bus including the Root Node except where specifically excluded.

IRD1394S000900 The Host shall interface to both 1394 buses in the FT1394 network through a Network Interface Card (NIC). [Host]

IRD1394S000910 The Network Interface (NI) shall implement S100 physical and link layer protocols per IEEE Standard 1394a-2000. [NI]

IRD1394S000920 Power for the NI link-layer shall be derived from the Host interface. [NI]

IRD1394S000940 Each Host shall contain primary and redundant Dual-Nodes. [Host]

IRD1394S000950 Each NI shall include two nodes. [NI] *Two (2) NIs form a quad tri-port.*

IRD1394S000960 Each prime and redundant Host shall attach to two (2) 1394 data buses through a Dual-Node, one Node for each data bus interface. [Host]

IRD1394S000970 All Hosts shall use the same FT1394 software driver. [Host]

DSU:The Data Server Unit receives all data to be formatted and sent to the ground.
SCP:The Spacecraft Control Processor serves as the source of all commands and Time-of-Day broadcasts, and acts as the Network Manager and Root Node including isochronous resource manager and cycle master functions.

PSP:The Payload Support Processor acts as a subnet router for each of the 1553 data buses. It collects data from the sensors and prepares it for transfer to the DSU. The PSP receives commands, Time-of-Day and data loads destined for 1553 based sensors and routes them to the appropriate sensor.

Test Equipment:This node is used for system testing by ground support equipment during I&T.

Spare:The spare node is provided for preplanned product improvement.

Hosts:Hosts act as science data sources and receive loads, commands and Time-of-Day to perform their function.

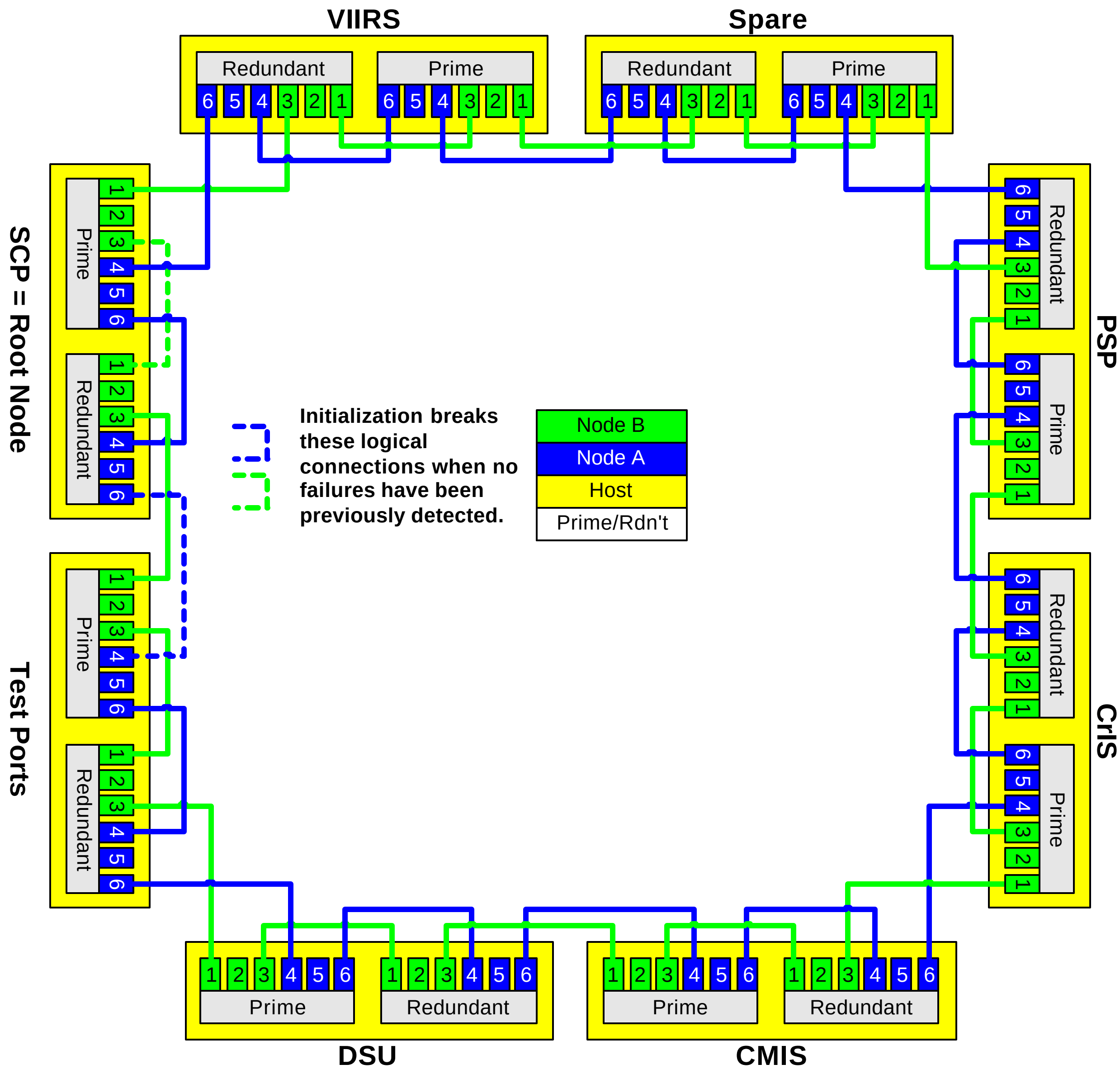

Figure 3.1.3-1 NPOESS FT1394 Topology

3.1.3.3.4 Fault Tolerance

IRD1394S200000 Hosts shall not initiate bus manager, cycle master or isochronous resource manager functions. [Host] {I}

IRD1394S200010 Any permanent or transient deviation from requirements due to any internal design including software shall be considered a fault. [Host] *A fault for the purpose of this document includes any and all failures or bit upsets regardless of cause.*

3.1.3.3.5 Bus Repeater

IRD1394S001100 Ports shall function as bus repeaters and re-synchronizers. [SC] A bus repeater re-synchronizer serves to relay data and protocol in keeping with the IEEE Standard 1394a-2000.

IRD1394S001110 Ports shall function as bus repeaters for implementing fault tolerant 1394 LAN topologies (cable configurations). [SC]

3.1.3.3.6 Maximum Physical System

IRD1394S001220 The system shall support all physical spacecraft layouts, from the minimum to maximum configurations that can be constructed using the elements of this document. [Driver]

IRD1394S001230 The system shall meet data transmission requirements independent of Host location or logical ring break location. [SC]

3.1.3.3.7 Fault Zones

IRD1394S200100 Physical layer circuits interfacing to the A and B buses shall be isolated from each other by greater than 1 Megohm DC with a tolerance of 5%. [NI] *To be measured or analyzed between node inputs, and between node inputs and chassis ground.*

IRD1394S200110 Prime and redundant physical layer circuits interfacing to the A or B buses shall be isolated from each other by greater 1 Megohm DC with a tolerance of 5%. [NI] *To be measured or analyzed between node inputs, and between physical layer grounds.*

IRD1394S200120 All physical layer circuits interfacing to the A and B buses shall be isolated from the Host by greater than 1 Megohm DC with a tolerance of 5%. [NI] *To be measured or analyzed between node inputs and host power/ground.*

IRD1394S200130 A fault anywhere within a network interface fault zone as defined by 3.1.3.3.7 IRD1394S200100, IRD1394S200110 and IRD1394S200120 shall not permanently propagate beyond that fault zone. [NI]

The fault zones architectural concept shown in Figure 3.1.3-2 may be used as a framework but usage of the diagram does not exempt the designer from any requirement in this document that the presented architecture may not satisfy.

3.1.3.3.8 Node Redundancy

IRD1394S001300 Nodes shall be dual standby redundant (Quad Tri Port) as shown in Figure 3.1.3-2. [Host]

3.1.3.3.9 Expandability

IRD1394S001400 Each 1394 Serial Bus shall be expandable to include up to 16 nodes. [SC, Driver] *The spacecraft is responsible for the total architectural performance* *and functionality regardless of size. The Driver is responsible for the ability to cope with networks or various sizes as defined in this document.*

IRD1394S001410 The system shall be configured with no node more than 16 hops from any other node. [SC]

IRD1394S001420 Bus repeaters shall count as hops. [SC]

IRD1394S001430 Redundant sides of nodes shall count as hops. [SC]

3.1.3.4 Interconnection

IRD1394S001500 Ports shall be interconnected using cable medium compliant to requirements in section 3.2.3.4 [SC]

3.1.3.4.1 Bus-to-Bus Isolation

IRD1394S001550 Configuration of Bus A and Bus B cables shall be such that no node on Bus A may communicate with a node on Bus B over the 1394 cable. [SC]

IRD1394S001560 Usage of Bus A and Bus B by the Host shall be such that no node on Bus A may communicate with a node on Bus B over the 1394 cable. [Host]

3.1.3.5 Network Power

IRD1394S001600 Power utilization and sources shall comply with section 3.2.3.6. [SC, Host] *Responsibility for compliance is as specified*.

IRD1394S001610 The Spacecraft shall provide power to each FT1394 data bus in such a manner that a single power supply failure on the FT1394 bus shall not cause the permanent loss of either data bus. [SC]

3.1.3.6 Node Operational Redundancy

IRD1394S001700 Each Host shall simultaneously receive data from both A and B 1394 bus. [Driver]

IRD1394S001710 Each Host shall output data as defined by the Network Manager to a specific network destination by Application Process Identifier (APID) as specified in section 3.2.8 [Host]

IRD1394S001720 Host shall provide secondary power to both NI link-layers. [Host]

IRD1394S001730 All Phys (physical layers) shall be powered from the FT1394 interface cable connector, even when the Host unit, prime or redundant, is un-powered. [NI-] *Therefore, it is probable that all four (4) PHYs will be powered concurrently in fault tolerant 1394 LAN configurations.*

IRD1394S001840 The Host shall support all four physical layers being simultaneously powered on. [Host]

IRD1394S001740 Power consumed from the 1394 cable shall be limited to the physical layer of the interface and its supporting circuitry. [NI]

IRD1394S001750 The FT1394 system Network Manager shall be designed to be hot standby such that only one is in active control of the FT1394 network but both shall be powered unless there is a failure. [NM] *Hot-standby means both prime and redundant units are powered and operational but only one is active and controlling the FT1394 network or supplying power to the FT 1394 network interface*.

IRD1394S001760 The hot-standby Root Nodes shall operate as any other Host nodes on the FT1394 network. [Root]

IRD1394S001770 Each A and B bus cable shall be powered by one of two mutually exclusive redundant spacecraft power sources. [SC] *The system therefore has four power sources.*

IRD1394S001780 The spacecraft using two unique UID addresses shall uniquely address each node within a powered Host unit, including both active and standby Root Nodes. [NI]

IRD1394S001790 The spacecraft using a unique IP address shall uniquely address each node within a powered Host unit, including both active and standby Root Nodes. [Driver]

IRD1394S001800 The driver shall support dual node communication where each node is on a separate and isolated bus. [Driver]

IRD1394S001810 The Host unit processor shall accept and correctly respond to commands received on either bus to output data on either bus of the powered NI. [Host]

IRD1394S001820 When commanded to output data on one tri-port the Host unit processor shall not output data to the other tri-port. [Host]

IRD1394S001830 UID designations shall be the same between host production units. [Host] *UIDs provided as part of configuration ROM load by NGST.*

3.1.3.7 Gap Time

IRD1394S001900 The system shall accommodate the range of inter-message gap time required to satisfy IEEE Standard 1394a-2000 required by 3.1.3.3.6. [Driver]

IRD1394S001910 The initial gap count shall be set to sixty-three (63). [Driver]

IRD1394S001920 Physical pinging shall be used for final gap count setting. [Driver]

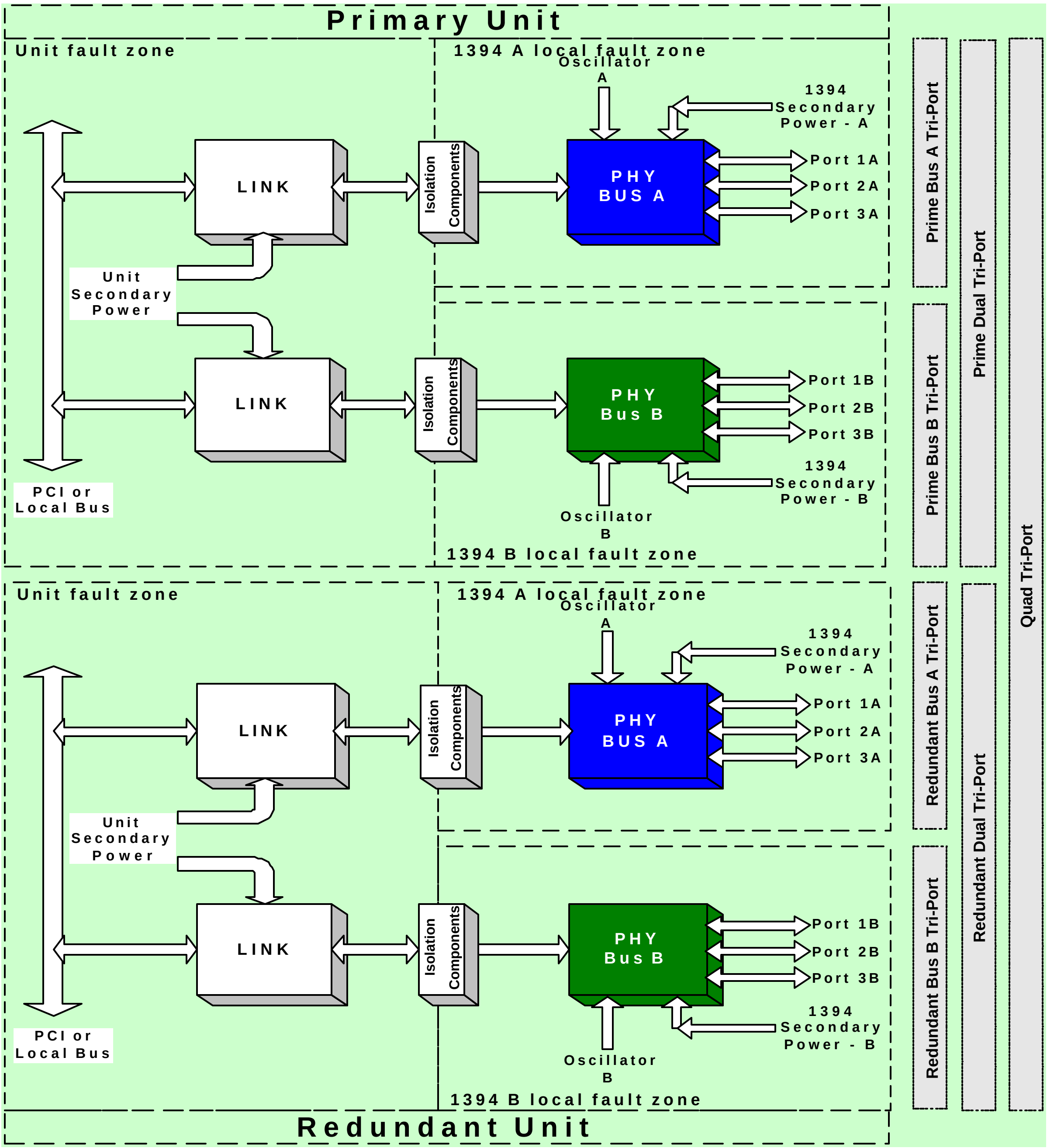

Figure 3.1.3-2. Dual Standby Redundant FT1394 Dual-Node

3.2 Functions

3.2.1 Network Management

3.2.1.1 Network Power Management

IRD1394S002000 The spacecraft network manager shall perform power switching of 1394 cable power as appropriate to maintain performance and correct faults. [SC]

3.2.1.2 Network Initialization

All requirements in this section and other sections that refer to "host 1394 initialization" also apply to "host 1394 re-initialization". Host 1394 ***initialization*** *performs all the functions necessary to prepare the driver and NI for data transport for the first time after power is applied to the host. Host 1394 re-initialization applies to subsequent calls to the driver to reset all variables and clear all buffers, resetting all state machines to the same as if the host had been initialized for the first time.*

3.2.1.2.1 Initialization Time

IRD1394S002100 The system shall complete nominal network initialization of the FT1394 A and B buses within two (2) seconds from the first bus reset [NM]. *At the end of initialization data transfers may begin. Reference initialization description requirements on NM not yet written*

IRD1394S002110 When cycling cable power, the Network initialization shall wait ≥ 16 (TBR) milliseconds following application of cable power. [NM, Ground]

3.2.1.2.1.1 Time for Tree Identify

IRD1394S002150 The maximum time for tree identify shall be less than 300 TBR milliseconds for a 16-node or less implementation. [NI]

3.2.1.2.1.2 Time for Self Identify

IRD1394S002160 Each node on the bus shall perform self-identification, per IEEE Standard 1394a-2000, within 16 TBR milliseconds of completion of its children self-identification. [NI]

3.2.1.2.2 Bus Initialization and Arbitration

The initialization mechanisms required for the FT1394 serial bus are best understood with reference to the IEEE Std 1394a-2000 Section 4.4.3. Below will provide only a general synopsis of the processes involved in operating the FT1394 bus in a cable environment.

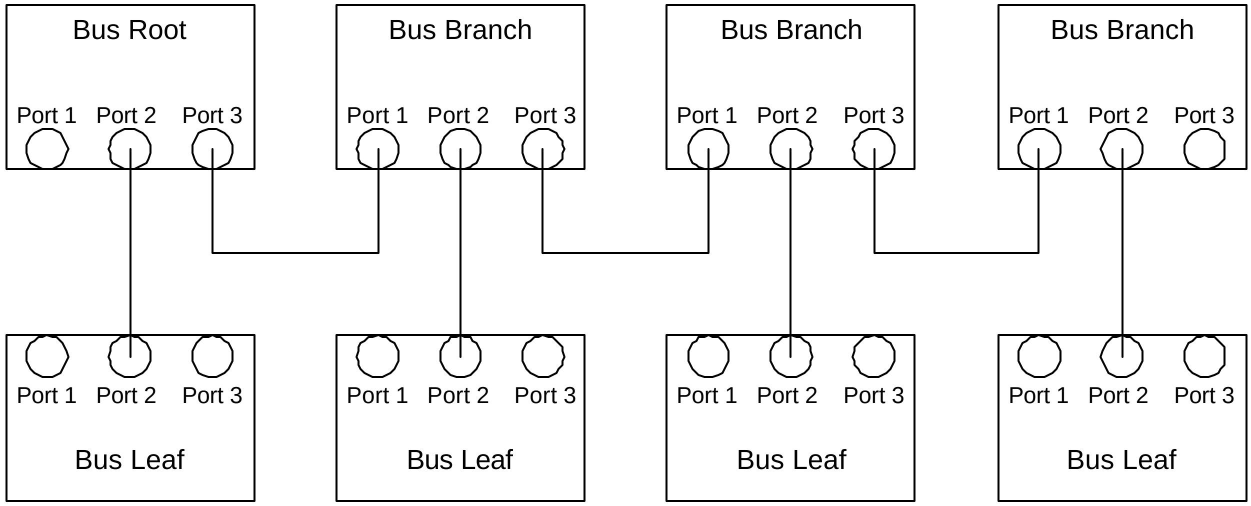

Figure 3.2.1-1 Bus Tree Topology

3.2.1.2.2.1 Bus-Reset

The bus-reset process starts when a bus-reset signal is recognized on an active port (not permitted by general interfaces in this implementation) or generated locally, e.g. a PHY power reset. Its purpose is to guarantee that all nodes propagate the reset signal. During the bus reset process each node sends out a BUS_RESET signal (i.e. Arb_A=1 and Arb_B=1) to all its connected neighbors. After completion of the bus reset, the transition is made to the tree-identify process.

On power reset, the PHY register values and internal variables are set up and all ports are marked disconnected. A solitary node transitions through the reset, tree-identify, and self-identify processes.

IRD1394S002200 A bus reset shall be initiated by power status changes at any PHY (not changes to LLC). [Host]

IRD1394S002210 A bus reset shall be initiated by a loss of Tp Bias. [NI]

IRD1394S002220 A bus reset shall be initiated by a bus-reset signal received from an attached node. [NI]

A node PHY that senses a BUS_RESET (i.e. Arb_A=1 and Arb_B=1) on any of its active ports' arbitration lines will start the bus-reset process. All nodes receiving the BUS_RESET signal will repeat the reset signaling to their other ports.

IRD1394S002230 A bus reset shall be initiated by a PHY detecting a MAX_ARB_STATE time-out. [Driver]

IRD1394S002240 A bus reset shall be initiated by a PHY receiving a bus-reset request initiated by SC software. [Driver]

IRD1394S002250 A bus reset shall be initiated by software within the Root Node. [Root]

IRD1394S002260 The bus-reset process shall terminate all traffic on the bus. [Host]

IRD1394S002270 Following a bus reset, the Network Manager shall logically break the physical ring by commanding a port to disable. [NM] *This does not break the power ring architecture.*

IRD1394S002280 The bus-reset process shall determine network topology information through the tree ID process. [Driver]

IRD1394S002290 The bus-reset process shall determine Physical ID (or node ID) through the Self-ID process. [Driver]

IRD1394S002300 The bus-reset process shall reset CSR registers as required by IEEE Standard 1394a-2000. [NI]

IRD1394S002310 Re-initializing the NI shall cause a bus reset. [Driver]

3.2.1.2.2.2 Tree Identify

The spacecraft SCP is the FT1394 Root Node.

The Root Node will, as part of the tree-identification process, check the bus configuration for loops, which are not allowed.

IRD1394S002400 The Network Manager shall logically break physical-loops. [NM]

IRD1394S002410 All Hosts shall be designed to be capable of being either a leaf or a branch. [Host]

After completion of the tree-identify process, the transition is made to the self-identify process.

3.2.1.2.2.3 Self-Identify

During the self-identify process each node uniquely identifies itself and communicate its characteristics to any management services.

The PHY waits for a grant from its parent or a self-ID packet from another node to perform self-identify.

Once permission is given to a node to send a self-ID packet, the node queries all its unidentified children for self-ID packets.

After all child ports are flagged as identified, the PHY sends its own self-ID packet.

The PHY enters an idle state following the transmission of its own self-ID packet.

3.2.1.3 Serial Bus Management

3.2.1.3.1 Cycle Master

IRD1394S002500 Only the spacecraft Root Node shall act as the serial bus cycle master. [Host]

3.2.1.3.2 Network Manager

IRD1394S002510 The FT1394 network shall include two Network Managers. [SC].

IRD1394S002520 Only the spacecraft Root Nodes shall act as the Network Managers. [Host]

3.2.1.3.3 Isochronous Resource Manager

IRD1394S002550 Only the spacecraft shall act as the isochronous resource manager. [Host]

3.2.1.4 Address Resolution Protocol (ARP)

IRD1394S002600 Address Resolution Protocol shall comply with 1394 OHCI Rel 1.0. [NI, Driver]

IRD1394S002610 ARP implementation shall comply with the IETF's RFC 2734. [Driver]

3.2.1.5 Bus Arbitration

IRD1394S002700 Nodes shall enter normal arbitration to send data. [NI]

IRD1394S002710 There shall be at least 63 levels of fair arbitration where 0 is not a valid number. [Driver]

IRD1394S002720 All levels of fair arbitration priority shall operate within fair arbitration intervals. [NI]

Normal arbitration is a simple request-grant handshake process that starts between a node and its parent (and all parents up to the Root).

3.2.2 Data Transfers

IRD1394S002800 Units utilizing the FT1394 serial data bus shall send and receive data in asynchronous mode. [Driver]

IRD1394S002810 Data transfers shall always transmit CCSDS packetized data in the same CCSDS APID order skipping over stale/unchanged CCSDS data packets. [Host]

3.2.2.1 Transaction Scheme

IRD1394S002860 “Fly-By” arbitration may be used but shall not be employed as a method to meet performance. [Host] *Fly-by arbitration is where an asynchronous packet is concatenated to an ACK or an isochronous packet is concatenated to a cycle start. The concatenation in this case occurs in a different node than the two currently communicating. This only relates to packets heading toward the Root. It does not include other concatenation.*

IRD1394S002870 The system shall support read and write transactions between nodes. [Driver]

IRD1394S002880 A Host shall only initiate a transfer when the entire CCSDS packet is available for transmission. [Host]

IRD1394S002890 Only whole CCSDS packets shall be transferred. [Host]

IRD1394S002900 Request for arbitration shall begin the process for transferring each CCSDS packet with priorities shown in Table 3.2.2-1. [Host]

IRD1394S002910 The Network Manager shall command the priority of request per Table 3.2.2-1. [NM]

IRD1394S002920 Partial CCSDS packets received shall be considered failed. [Host]

IRD1394S002930 The receiving Host shall drop failed CCSDS packets. [Host]

IRD1394S002940 The Host shall transfer one CCSDS packet at a time to the 1394-driver. [Host]

IRD1394S002950 The 1394-driver shall transmit CCSDS packets in same order as they were sent to the driver. [Driver]

IRD1394S002960 The physical layer (network access layer) number of retries shall be programmable. [Driver, NI]

IRD1394S002970 The physical layer (network access layer) number of retries shall initially be set to one (1). [Driver]

Physical packets will be variable in size based on quadlet boundaries.

IRD1394S002980 Physical packet size shall be adjusted to the nearest quadlet boundary. [Driver]

Table 3.2.2-1 Arbitration Priority

Priority TBR	Host	1394 Physical Packet Size (quadlets) TBR
2	SCP	128
2	PSP	128
2	CMIS	128
2	CrIS	128
32	VIIRS	128
2	DSU	128
0	Spare	0

3.2.2.1.1 FT1394 Packet Size

IRD1394S003000 NGST shall determine the physical packet size. [SC]

This does not imply the sizes of the CCSDS packets transmitted through the FT1394 bus.

3.2.2.1.2 Deleted

3.2.2.2 1394 Broadcast

IRD1394S003020 Broadcast commands shall employ the asynchronous data transfer mode. [NM]

IRD1394S003030 Hosts except the Root Node shall not issue broadcast messages. [Host]

IRD1394S003040 All nodes shall recognize a broadcast transaction. [Driver]

IRD1394S003050 Receiving nodes shall not return any response or acknowledgement to a broadcast command. [Driver, Host]

IRD1394S200270 There shall be no retry for broadcast transfers at any layer of the 4-layer protocol model called out as the basis for this document in section 1.1. [Host]

3.2.2.3 1394 Multicast

It is recommended that 1394 multicast not be employed.

3.2.3 Physical and Link Layer

3.2.3.1 Common Implementation

IRD1394S003100 All Hosts transmitting or receiving data on the FT1394 network shall employ the same Physical Layer chipset, Link Layer chip and connectors. [Host]

3.2.3.2 Physical and Link Layers

IRD1394S003110 The sending node delay from bus grant to start of transaction shall be less than 1.29 TBR microsecond. [Host]

IRD1394S003120 The receiving node shall produce the corresponding acknowledge to the sender in less than 50 nanoseconds after completion of the packet. [Host]

3.2.3.3 Multicast Over FT1394IP Multicast

IP Multicast mode should not be used.

3.2.3.4 Cables

3.2.3.4.1 Finished Cables

IRD1394S003200 The FT1394 S100 cable shall meet all 1394 performance parameters up to a length of 18 meters as measured from connector end to connector end. [SC]

IRD1394S003210 When employing 18-meter cables the spacecraft contractor shall provide test or analysis sufficient to validate the compatibility with each node of the system driving or receiving signals when employing a longer cable length over all environmental conditions. [SC]

IRD1394S003220 The spacecraft cable system shall be sufficiently shielded to prevent energy leakage that may cause electromagnetic interference (EMI) in compliance with the RS and RE EMI requirements in D31418. [SC]

IRD1394S003230 Interconnecting cable shall be six wire cables complying with signal quality requirements contained in the 1394a-2000 specification. [SC] *For purposes of* *this specification: TPA and TPB are the two low-voltage, low current, bi-directional differential signals per port that carry data bits or arbitration signals, and, Vp and Vg are the power and return pair that provide the current needed by the physical layer.*

IRD1394S003240 Cable shall exhibit a signal impedance of 110 $\pm$ 6 ohms. [SC]

IRD1394S003250 Cable for FT1394 shall meet performance, environmental and EMC requirements with a minimum bend radius of 10 times the cable diameter. [SC]

IRD1394S003260 The cable shall withstand all of the environmental requirements for the duration of the mission per D31418. [SC]

IRD1394S003270 The shields around the data pairs shall be electrically connected throughout the length of the cable. [SC]

IRD1394S003280 The outer shield(s) shall be isolated from the inner data pair shields within the cable. [SC]

3.2.3.4.2 Connector Designators

IRD1394S003300 Each connector group of three ports on the Host shall be designated and marked for connection matching Figure 3.2.3-1 and lettered with an A or a B for the associated Bus. [NI]

IRD1394S003310 Each cable end connector shall have a color-coded band matching Figure 3.2.3-1/Figure 3.2.3-2and lettered with an A or a B for the associated bus. [SC]

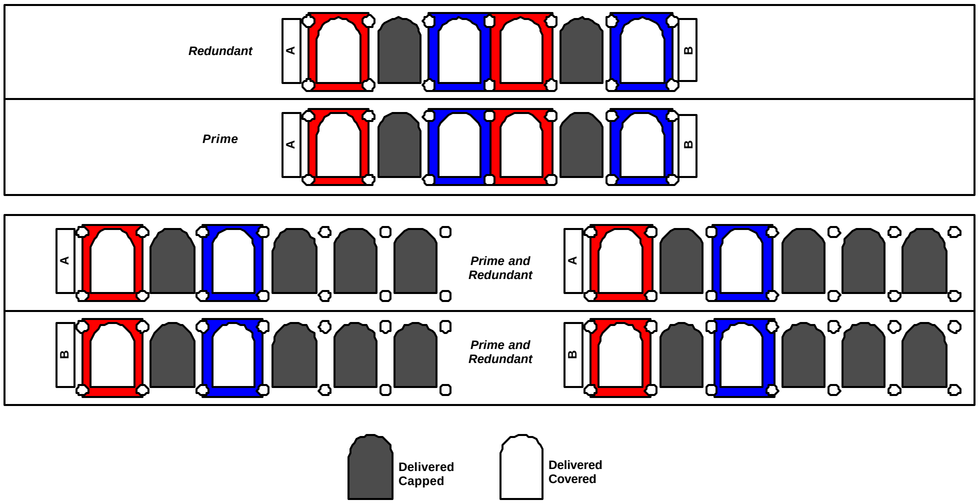

Figure 3.2.3-1 Host NI Connector Labeling

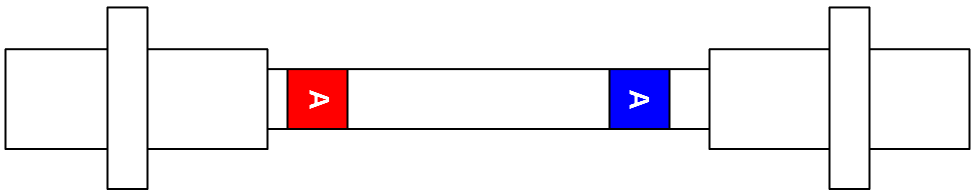

Figure 3.2.3-2 Cable-End Labeling

3.2.3.4.3 Connectors

IRD1394S003320 All connections to the FT1394 network shall mate using the same connectors. [NI, SC]

IRD1394S003330 The FT1394 connector shall be self-aligning. [NI, SC]

IRD1394S003340 The FT1394 connector shall withstand up to 100 mate/demate cycles without detectable degradation to electrical or mechanical properties. [SC, NI]

IRD1394S003350 The connector shall be qualified to meet environment requirements as defined in the D31418. [NI]

IRD1394S003360 Connectors shall be qualified in the design implementation to meet the D31418. [NI]

IRD1394S003370 Connectors shall exhibit a signal impedance of 110 $\pm$ 6 ohms. [NI]

3.2.3.4.3.1 Connector Pin-outs

IRD1394S003400 All FT1394 connections shall use the same pin number to signal definitions as defined in D36381. [Host]

3.2.3.4.3.2 Connector Mating

Connector savers will be used per GIID requirements IF231530 and IF231535.

IRD1394S003410 Connector markings shall be clear and obvious to ensure correct system connectivity. [Host]

IRD1394S003420 The Host contractor shall limit mate/de-mate cycles to less than 50 including allowance for rework. [Host]

IRD1394S003430 Spacecraft storage testing shall limit mate/de-mate cycles to less than 10. [SC]

IRD1394S003440 Spacecraft I&T and system test shall limit mate/de-mate cycles to less than 25. [SC]

3.2.3.4.4 Connector Identification

IRD1394S003460 Connector installation shall reduce the probability of misconnection by color-coding both the cable mounted and unit mounted connectors, on the Host surface near or surrounding the connector per Table 3.2.3-1 [NI]

Table 3.2.3-1 Connector Identification

Connector	Color
Port 1	**Red**
Port 2	**White**
Port 3	**Blue**

3.2.3.4.5 Deleted

3.2.3.4.5.1 Deleted

3.2.3.4.6 Bulkhead Feed Through Connectors

IRD1394S003470 Connectors implemented to cross through bulkheads or traverse mechanical structures in the spacecraft shall be included in the signal integrity analysis for long cables. [SC]

IRD1394S003480 Connectors implemented to cross through bulkheads or traverse mechanical structures in the spacecraft shall meet all RS and RE EMI requirements in the D31418. [SC]

IRD1394S003490 Bulkhead connectors shall meet requirements in section 3.2.3.4.3. [SC]

3.2.3.5 1394 Electrical Interface

IRD1394S003500 The FT1394 Bus signal and power interface characteristics shall meet all electrical requirements of the IEEE 1394 S100 Serial Bus as specified in the IEEE 1394-1995, IEEE 1394a-2000, and D31418. [Host]

3.2.3.5.1 Network Cable to Host Isolation

IRD1394S003510 FT1394 serial network interface design shall implement galvanic isolation while meeting signaling and data transfer performance. [NI]

IRD1394S003530 Hosts shall implement isolation between the cable ground and power, and, the Host ground and power in the presence of common mode voltages up to ± 5 Volts DC. [NI]

IRD1394S003540 The spacecraft and EGSE containing 1394 shall be designed to limit differential ground potential between any two Hosts on the FT1394 data bus to 2.5 volts DC. [SC, GSE]

3.2.3.6 Power

3.2.3.6.1 Cable Power

IRD1394S003600 The Physical Layer (all portions) shall derive power from the FT1394 cable. [NI]

IRD1394S003610 Power from the cable shall be used for the physical layer only and shall be isolated from other circuits. [NI]

IRD1394S003620 Host nodes shall relay power from node to node such that power output to the cables never exceeds power input from the cables. [NI]

IRD1394S003630 Physical Layer power to the physical layer interface and logic circuits shall be un-powered when the cable is un-powered. [NI]

IRD1394S003640 No single failure within a Host NI shall be permitted to source unit supplied power onto the FT1394 cable. [NI]

IRD1394S003660 Host 1394 Initialization before application of cable power shall continue normally such that Host operations will begin and not preclude normal operations upon application of cable power. [Host]

3.2.3.6.2 Cable Power Distribution

IRD1394S003700 Users of 1394 cable power shall meet both CE and CS requirements of the D31418. [NI]

IRD1394S003710 Cable power voltage shall be 22 to 38.6 volts. [SC]

IRD1394S003720 Under normal conditions, power drawn from the cable for each node shall be less than or equal 275 milliamps peak when the bus voltage is less than 38.6Volts. [NI]

IRD1394S003725 Under other than normal conditions, power drawn from the cable for each node shall be less than or equal to 400 milliamps while voltage is less than 38.6Volts. [NI]

IRD1394S003730 The power interconnection between ports of a node shall be capable of conducting node-to-node 3 amperes steady state and peak of 9 amperes for up to 250 milliseconds. [NI]

IRD1394S003740 Cable power shall be distributed to each Host physical layer interface. [NI]

3.2.3.6.3 Cable Power Source

IRD1394S003800 The spacecraft shall provide redundant cable power sources dedicated to each FT1394 bus (A bus and B bus). [SC]

IRD1394S003810 Cable power shall be supplied by redundant independent sources. [SC]

IRD1394S003820 Cable power input shall contain a common system power filter meeting the D31418. [SC]

IRD1394S003830 The cable power source shall provide over-voltage and short-circuit protection. [SC]

IRD1394S003840 Cable power source shall meet the requirements of Table 3.2.3-2. [SC]

IRD1394S003850 Each cable power source shall be capable of being independently switched. [SC]

IRD1394S003860 Upon application of cable power, inrush energy into any node shall not exceed 18 mJ in 3 ms. [NI]

Condition	Limit	Units
Maximum network series bus current	3.0	A_{dc}
Minimum voltage input	22	V_{dc}
Maximum voltage input	38.6	V_{dc}
Maximum input ripple (10kHz to 400MHz)	1%	Vin
Maximum input ripple (below 10kHz)	1	V p-p

Table 3.2.3-2 Cable Power Specifications

3.2.3.6.4 Power and Ground Isolation

IRD1394S003900 Each physical layer on the A bus shall be galvanically isolated from all physical layers on the B bus. [NI]

IRD1394S003910 Each physical layer on the A bus shall be galvanically isolated from all link layers. [NI]

IRD1394S003920 Each physical layer on the B bus shall be galvanically isolated from all link layers. [NI]

IRD1394S003930 The isolation withstanding voltage rating shall be +/- 5.0 volts. [NI]

3.2.3.6.5 Power Sequencing

IRD1394S004000 The system and all of the FT1394 hosts shall arrive at normal operations without external involvement, subsequent to any combination of power sequencing events that lead up to both the host and the cable power being applied. [NI, Driver, Host]

IRD1394S004010 Loss of cable power shall cause the physical layer circuitry to clear all SEU induced or otherwise previously set up PHY states, regardless of the state of the Host. [NI]

IRD1394S004040 The NI shall survive without degradation any duration of voltage between 0 and 22 volts DC applied by the cable. [NI]

IRD1394S004050 The source of a cable power ON command shall send the command only after cable power has been OFF for ≥ 1 second. [SC, Gnd]

IRD1394S004060 Commanding cable power ON from an ON state shall not produce cable power discontinuities. [SC]

3.2.3.7 Grounding

IRD1394S004100 Physical layer grounds shall be isolated from chassis and Host grounds by greater than 1 +/- 5% Megohm. [NI]

Physical layer grounds are isolated from each other by greater than 1 +/- 5% Megohm per IRD1394S200100.

IRD1394S004120 Physical layer grounds shall be connected to cable power return (Vg). [NI]

IRD1394S004130 Within the Host near the 1394 cable connector, the cable power return (Vg), and thus the cable inner shields (see IRD1394S004180 below), shall be connected to chassis ground through a capacitor as shown in Figure 3.2.3-3. [NI] *ESR for a capacitor specified at a single frequency may be calculated by multiplying the specified ESR $_{@ Fs}$ at the frequency specified (Fs) by the square root of the F $_{desired}$ divided by Fs. This relationship is well behaved at RF and accounts for the "skin effect".*

IRD1394S004140 The capacitor used for terminating the inner cable shield shall be equal to 0.001 +/- 20% microfarad with an equivalent series resistance of less than 10 ohms from 25 to 1000 MHz. [NI]

IRD1394S004160 The cable outer shield shall be connected to chassis ground through the connector shell. [NI]

IRD1394S004170 The system shall return each cable power return (Vg) to spacecraft single point ground through a common mode power filter. [SC]

IRD1394S004180 The cable inner shields shall be connected to cable power return (Vg) at the cable connector at each end of the cable as shown in Figure 3.2.3-3. [SC]

IRD1394S004190 The chassis of the 1394 network Host shall be isolated from cable power return, Vg. [NI]

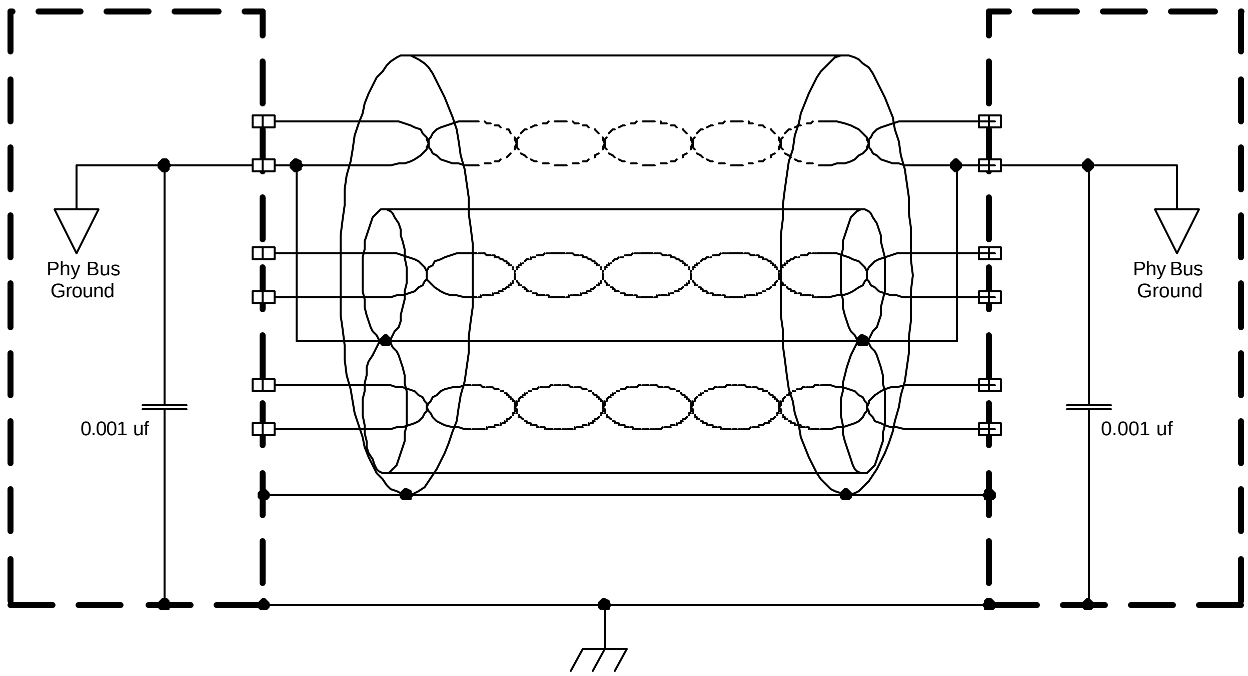

Figure 3.2.3-3 Inner Shield Termination

3.2.3.7.1 Single Point Ground

IRD1394S004200 The impedance between the chassis connections of any two series connected network users shall be less than 100 milliohms. [SC]

3.2.3.8 Fault Tolerance

3.2.3.8.1 Faults

IRD1394S200200 No single credible failure within a node shall be capable of overloading the cable supplied power source. [NIC] *For clarification, the definition of a "Credible Failure" is a failure that was anticipated in the system's design and preventive measures were not implemented to preclude such failure or to reduce the risk to the system to an acceptable level (low probability) should such a failure occur.*

IRD1394S200220 No single credible failure within the spacecraft shall be capable of causing the permanent removal of power from any two nodes including the source of the failure. [SC]

IRD1394S200230 No single credible failure within a Host interface shall be capable of violating the isolation requirements. [NI]

IRD1394S200240 No single credible failure shall be capable of propagating to another interface on the same bus. [NI]

IRD1394S200250 No single credible failure within a node on one bus shall be capable of propagating to the other bus. [NI]

3.2.3.8.2 Redundancy

IRD1394S200300 Each Host implementing FT1394 Serial bus shall provide two completely redundant interface hardware sets (i.e. dual redundant) internal to the unit as shown in Figure 3.2.3-4. [Host]

IRD1394S200310 Each redundant hardware interface shall incorporate two nodes. [NI]

IRD1394S200320 Each host shall contain primary and redundant pairs of nodes. [Host] *The combination of ports of a particular host can be referred to as a Quad Tri Port*.

IRD1394S200330 One node shall be connected to bus A with the other node connected to bus B. [SC]

IRD1394S200340 Both nodes within a powered Host shall be individually addressable and operational regardless of the state of the other node. [Host]

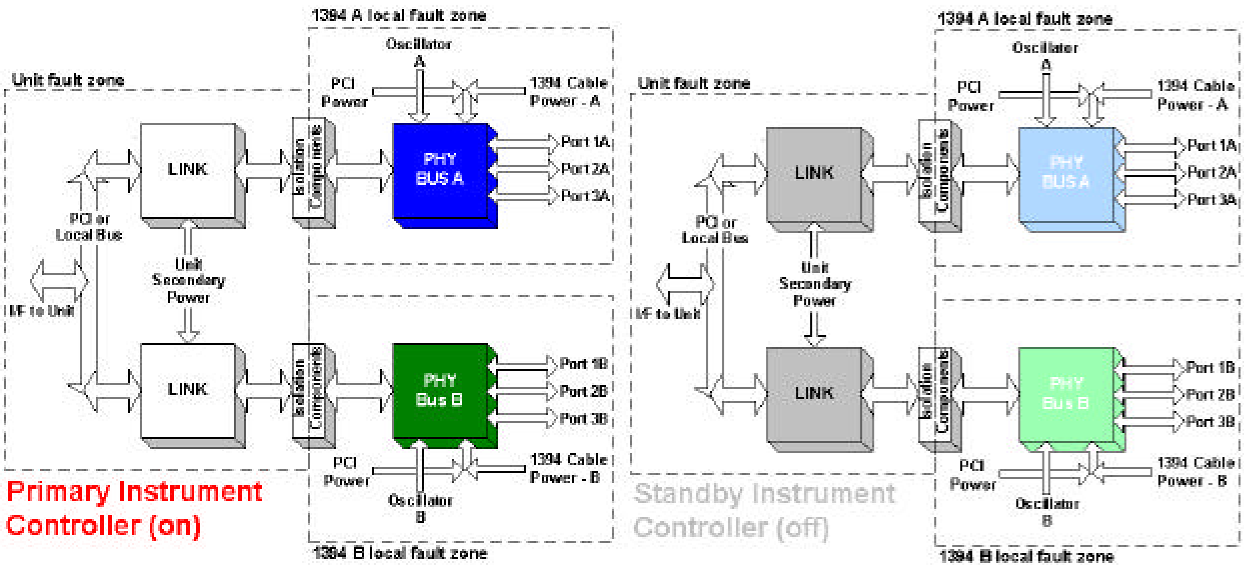

Figure 3.2.3-4 Quad Tri Port Configuration

The Quad Tri Port configuration has a total of six ports on the primary side and six ports on the redundant side. Of the six ports, three provide the interface to the A 1394 bus and three the interface to the B 1394 bus. This provides full cross strapping between all of the prime Hosts and the redundant Hosts via the A and B buses. . Any primary or redundant Host can interoperate with any other primary or redundant Host. The dual bus permits simultaneous traffic and fault isolation from a Host, where the bus master can continue normal communications to a Host via a rerouted link path and attempt fault isolation and correction on a defective node or link. The dual bus provides maximum reconfiguration capability at the expense of more interconnections. Should one Host be switched to the B bus or redundant Host side, this configuration allows all other interconnected Hosts to remain on their primary side using the A bus. Thus a fatal failure in one system's 1394 interface does not force the bus master to switch all systems to their backup units.

3.2.4 Network Layer

IRD1394S004300 All references to IP shall specifically relate to IPv4. [Driver]

3.2.4.1 Common Implementation

IRD1394S004310 All Hosts transmitting or receiving data on the FT1394 network shall employ the same network layer software. [Host]

3.2.4.2 Network Class

The spacecraft and Hosts should implement a Class B netwo rk. In a class-B network, the first pair of bytes of the quadlet IP address specifies the network number, and the *second pair of bytes specifies the Host within a network. Allowed class-B network numbers range from 128.0 to 191.255; allowed Host numbers range from 0.1 to 255.254. (The special Host number 255.255 is reserved for broadcasts).*

3.2.4.3 IP Addresses

IRD1394S004330 The spacecraft shall implement two Class B specific “network numbers” within the range 172.15 to 172.31 where one is for Bus A and one is for Bus B. [SC]

IRD1394S004340 The special Host broadcast network number 255.255 shall be reserved for broadcast. [Driver]

IRD1394S004350 Static IP addressing shall be used. [Driver]

IRD1394S004360 All nodes shall accept messages on both their specific IP address and the special Host broadcast IP address. [Driver]

IRD1394S004365 Each host network interface, consisting of a node for bus A and a node for bus B, shall use the same last 2 bytes of the IP address for both Bus A and Bus B. [Host]

IRD1394S004366 Each Host, except the Root, shall use the same last byte of the IP address for both Primary and Redundant host network interfaces. [Host] {I}

IRD1394S004367 The Root shall use a different last byte of the IP address for Primary and Redundant units. [Host] {I}

3.2.4.4 Error Handling

3.2.4.4.1 Physical Layer Packet Loss Affect

IRD1394S004380 A loss of one or more physical layer packets that are part of an IP Datagram shall result in the loss of the IP Datagram. [Driver]

3.2.5 Transport Layer

IRD1394S004400 Asynchronous and Isochronous data transfers over the spacecraft on-board FT1394 LAN shall use User Datagram Protocol (UDP) transport layer protocol (refer to RFC-768, RFC-791, and RFC-2734). [Driver]

3.2.5.1 Common Implementation

IRD1394S004410 All Hosts transmitting or receiving data on the FT1394 network shall employ the same Transport Layer software. [Host]

3.2.5.2 Auxiliary Networking Functions

3.2.5.2.1 Output Threads

IRD1394S004440 A single block of data passed to the driver shall be received as the same single block of data at the application layer. [Driver]

3.2.5.3 Error Handling

3.2.5.3.1 IP Datagram Loss Affect on UDP Layer

IRD1394S004470 The loss of one or more IP Datagrams shall cause the loss of the associated UDP Datagrams. [Driver]

3.2.6 Application Layer

3.2.6.1 Host Data Protocol (CCSDS)

IRD1394S004500 All application-layer peer-to-peer data communicated across the FT1394 network shall be formatted per CCSDS 701.0-B-2, and 301.0-B-2 using the CCSDS Path Protocol Data Unit (CP_PDU) format (also known as Version 1 Source Packet). [Host]

IRD1394S004510 CCSDS format header contents of the CCSDS Path Protocol Data Unit (CP_PDU) packets shall be used as the application layer interface protocol. [Host]

3.2.6.1.1 CCSDS Packet Boundaries

IRD1394S004520 All CCSDS packets shall be on byte boundaries. [Host]

3.2.6.1.1.1 Byte/Octet Padding

IRD1394S004530 No padding shall be appended within the CCSDS packet to fix the length of a CCSDS packet that contains a variable length data field. [Host]

3.2.6.1.2 Data Packet Size

IRD1394S004540 The size of packets shall not exceed Table 3.2.6-2 for telemetry and Table 3.2.6-3 for commands. [Host, SC, Ground]

3.2.6.1.3 Content and Structure

IRD1394S004600 Data packets using the same Application Process ID shall have the same contents and structure. [Host, SC, Ground]

IRD1394S004610 Assigning different Application Process ID's shall accommodate different contents and structures. [Host, SC, Ground]

IRD1394S004620 Sub-commutation within telemetry APIDs shall be employed when a single CCSDS packet is too large. [Host]

IRD1394S004630 Sub-commutation within a command or memory load APID shall not be employed. [Ground]

IRD1394S004640 Sub-commutation within an APID shall contain data of the same type as specified by the APID. [Host, SC]

IRD1394S004650 Sub-commutation within an APID shall contain at the beginning of each data field a sub-frame designator such that it is easily differentiated from the other sub-frames within that APID to provide uniqueness. [Host, SC]

IRD1394S004680 Sub-commutation within a TMON packet type shall not be employed. [Host]

IRD1394S004660 The Host shall segment all data packets longer than permitted by section 3.2.6.1.2 before transferring. [Host]

IRD1394S004670 Each segmented packet shall be less than the maximum length specified in section 3.2.6.1.2. [Host]

3.2.6.1.3.1 Primary Header

3.2.6.1.3.2 APID

IRD1394S004700 Application Process Identifiers (APIDs) contained in segmented packets shall remain the same throughout all CCSDS packet segments, which are part of the Data Set being sent. [SC, Host, Ground]

3.2.6.1.3.3 Sequence Flag:

IRD1394S004710 The sequence flag for a segmented packet shall follow the following protocol: “01” for the first segmented packet, “10“ for the last segmented packet, “00” for the in-between segmented packets, 11 for un-segmented packets [SC, Host, Ground] *Packets may proceed from first packet to last packet without any middle packets*.

3.2.6.1.3.4 Packet Sequence Count:

IRD1394S004720 Packet sequence-count (primary header) in a CCSDS packet shall monotonically increase for all packets of the same APID. [SC, Host, Ground]

IRD1394S004730 The packet sequence count in the primary header in a CCSDS packet shall, under normal operational conditions, only be 00 by virtue of a count rollover. [SC, Host, Ground]

3.2.6.1.3.5 CCSDS Packet Header Location

IRD1394S004740 The first bit of a new CCSDS application packet shall be the first bit of data in a UDP Datagram. [Host]

3.2.6.1.3.6 Secondary Header

IRD1394S004750 The secondary header shall only exist for the first packet of a segmented CCSDS packetized data set and a standalone packet except TMON and LEO&A packets. [SC, Host, Ground]

3.2.6.1.3.7 Time-of-Day

IRD1394S004760 The first 8 octets of the secondary header shall be the Time-of-Day from the time data broadcast by the spacecraft. [SC]

IRD1394S004770 The Time-of-Day shall be related to the time of observation for the first data within the data field such that the uncertainty of the time tag meets IRD1394S007140. [Host]

IRD1394S004780 The Time-of-Day shall employ the format in section 3.2.11 [Host, SC]

3.2.6.1.3.8 Number of Packet Segments

IRD1394S004790 The ninth octet of data in the secondary header shall be the number of packet segments field containing the total number of packets expected for this CCSDS packet set minus one. [Host, SC, Ground]

3.2.6.1.4 CRC and Checksums

3.2.6.1.4.1 Telecommand CRC Usage

IRD1394S004800 The usage of CRC or checksums for commands shall be at the discretion of the Host provider. [Host] *The spacecraft contractor discourages the use of these codes for general commands. Host memory and table loads may want to use checksum.*

3.2.6.1.4.2 Telemetry CRC Usage

IRD1394S004810 CRC and checksums shall not be implemented. [Host]

3.2.6.1.5 Application Identifiers (APIDs)

3.2.6.1.5.1 APIDs and Packet Types

IRD1394S004830 All Host source packets (CP_PDU) shall contain the appropriate APID as listed in D35853. [Host]

IRD1394S004840 Host data bus command and memory load source packets (CP_PDU) shall contain the appropriate APID and shall be transmitted by the spacecraft to their destination Host according with their APID. [SC, Ground]

3.2.6.1.5.1.1 APIDs and Source Packet Selection

IRD1394S004850 The Host shall uniquely characterize data by APID assignment except as provide by section 3.2.6.1.3. [Host] *This requirement is to disallow lower subdivisions of data below the APID level.*

IRD1394S004860 The spacecraft shall support the selection of packets by APID. [SC]

3.2.6.1.5.1.2 APIDs and Compressed Data

IRD1394S004870 Same or similar type data shall employ unique APIDs for uncompressed data and compressed data versions. [Host]

3.2.6.1.5.2 APID Packet Documentation

IRD1394S004880 For fixed entropy data, the Host contractor shall document the contents, maximum packet size, maximum packet rate, average data rate, and all packet contents for each APID and for each Host mode. [Host]

IRD1394S004890 For variable entropy data, the Host contractor shall document the contents, predicted packet size range, maximum packet rate, predicted orbital average data rate, and all packet contents for each APID and for each Host mode. [Host]

IRD1394S004900 The Host contractor shall document the sequence of CCSDS packets per functional cycle per mode of operation. [Host]

3.2.6.1.5.3 APID Assignment

IRD1394S004910 All APIDs except the ground command APID shall be capable of being reassigned after delivery to the spacecraft contractor, but before launch, without removal of the Host from the spacecraft. [Host, SC] *Without this fixed APID it would not be possible to reprogram the others.*

IRD1394S004920 After launch, APIDs shall remain fixed throughout the mission life. [Host, SC, Ground]

3.2.6.1.5.4 APID Reuse

IRD1394S004930 APIDs assigned but not used for a specific spacecraft configuration shall not be reassigned to another use unless the original assignment is permanently retired. [Host, SC]

3.2.6.1.5.5 Telecommand APIDs

IRD1394S004940 Each Host shall have four (4) unique APIDs allocated for spacecraft and ground commands (2) and memory loads (2). [Host]

3.2.6.1.5.6 Command APIDs

IRD1394S004950 Each host shall have two (2) APIDs for commands. [Host]

IRD1394S004960 One APID shall define a command from the ground. [Host]

IRD1394S004970 One APID shall define a command from the spacecraft. [Host]

3.2.6.1.5.7 Memory Load APIDs

IRD1394S004980 There shall be two (2) APIDs for memory loads. [Host]

IRD1394S004990 One APID shall define a memory load from the ground. [Host]

IRD1394S005000 One APID shall define a memory load from the spacecraft. [Host]

3.2.6.2 Telemetry

3.2.6.2.1 Telemetry Maximum Bandwidth

IRD1394S005100 Hosts shall design their maximum rate of data generation so as not to lose any data when the FT 1394 data bus accepts data at their contract specified peak rates on a per second basis and allowing for network throttling per 3.2.6.2.3.1. [Host]

3.2.6.2.2 Host Data Types

IRD1394S005110 Data type assignment to packet types shall require approval of the spacecraft contractor and shall be documented in their respective ICDs. [Host]

3.2.6.2.2.1 Housekeeping Data

IRD1394S005120 Housekeeping data shall be as defined in the Host ICD. [Host]

IRD1394S005130 Any data required for processing mission science data shall be excluded from housekeeping data. [Host] *Time-of-Day is not data by this definition. It is secondary header information only.*

3.2.6.2.2.1.1 Housekeeping Data Rate

IRD1394S005140 Host housekeeping data shall be generated continuously in normal mode. [Host, SC]

IRD1394S005150 Host housekeeping data shall be generated at an orbital average rate not to exceed 2048 bps. [Host]

IRD1394S005160 Host housekeeping peak data rate as averaged over any scan cycle or 1 second period shall be less than or equal to 2048 bps or shall meet requirement IRD1394S005170. [Host]

IRD1394S005170 When housekeeping peak data rate over a 1 second period exceeds 2048 bps the Host shall be capable of buffering the data so as to prevent data loss when the spacecraft accepts the data at 2048 bps. [Host]

IRD1394S005180 The spacecraft shall accept housekeeping data from each sensor at 2048 bps over any one-second period. [SC]

3.2.6.2.2.1.2 Housekeeping Data Timeliness

IRD1394S005190 The delay between housekeeping data generation and availability for transmission onto the data bus shall not exceed 2 seconds plus the fundamental instrument scan or data production cycle. [Host, SC]

3.2.6.2.2.2 LEO&A

IRD1394S005200 A pre-defined critical proper subset of Host Engineering and Housekeeping, Critical Data, shall be extracted by the Host and sent to the spacecraft using a dedicated APID. [Host, SC]

IRD1394S005210 Critical Data shall be as documented in the Host ICD. [Host]

3.2.6.2.2.2.1 LEO&A Housekeeping Data Rate

IRD1394S005220 Host LEO&A packets shall only contain critical data and be generated continuously at a rate not exceeding 256 bps. [Host]

IRD1394S005230 The spacecraft shall accept data from each sensor at 256 bps or less over any one-second period. [SC]

3.2.6.2.2.3 Calibration Data

IRD1394S005250 Calibration data required for Host calibration, alignment, and data processing shall be as documented in the Host ICD. [Host]

3.2.6.2.2.4 Dwell Data

IRD1394S005260 Dwell data shall be as documented in the Host ICD. [Host]

3.2.6.2.2.5 Science Data

IRD1394S005270 Science data shall be broken into multiple packet types such that the data is capable of being sorted by APID as required by the algorithms that operate on the Host data. [Host]

IRD1394S005410 Science packets shall consist of Host measurement and observation data, whether processed or raw, such that the combination of science data and engineering data is sufficient to achieve specified performance as determined by the supplier of the associated mathematical algorithms. [Host]

3.2.6.2.2.5.1 Science Data Rate

IRD1394S005280 The average and peak science data rates of a Host shall not exceed the data rates contained in the Host contracted specification. [Host]

3.2.6.2.2.6 Diagnostic Data

IRD1394S005300 Host diagnostic data shall be any Host data other than normal engineering data and science data that are down-linked to support ground diagnosis of Host anomalies. [Host]

3.2.6.2.2.6.1 Diagnostic Data Rate

IRD1394S005310 The combined output rate of science data and diagnostic data of a Host shall not exceed the maximum contract specified science data rate of the Host unless a mission control and operation procedure causes another sensor to not produce data during the period. [Ground]

3.2.6.2.2.6.2 Diagnostic Data Transfer

IRD1394S005320 Diagnostic data shall be broken into multiple packet types such that the data is capable of being sorted by APID as required by the algorithms that operate on the Host data [Host]

3.2.6.2.2.7 Engineering Data

IRD1394S005330 Engineering packets shall consist of all data required to meet specified science data processing performance, contained in their deliverable specification, such that the combination of science data and engineering data is, without excess, sufficient to achieve specified performance as determined by the supplier of the associated mathematical algorithms. [Host]

3.2.6.2.2.8 Telemetry Monitor Data (if necessary)

IRD1394S005340 If a Host requires an action by the spacecraft; the Host contractor shall supply the appropriate algorithm associated with each data item within a telemetry monitor packet to the spacecraft contractor. [Host]

IRD1394S005350 Telemetry Monitor packets shall be used to request an action by the spacecraft. [Host]

IRD1394S005360 Telemetry Monitor packets shall contain only the information required for the specified action by the supplied algorithm. [Host]

IRD1394S005370 All supplied requirements for spacecraft actions associated with telemetry monitor packets shall be documented in the Host ICD. [Host]

IRD1394S005380 All Telemetry Monitor requirements from the Host contractor shall be by agreement with the spacecraft contractor. [Host]

3.2.6.2.2.9 Memory Dump Data

IRD1394S005400 Memory dump packets shall consist of data contained within a range of memory of the Host as documented in the Host ICD. [Host] *A incorrect access could lock up CPU upon register access.*

3.2.6.2.2.10 Deleted

3.2.6.2.3 Host Telemetry Data Transfer Process

IRD1394S005420 Packet transfers shall be the minimum size to contain the required headers and data. [Host] *Fill is not to be used to approximate a fixed length packet.*

3.2.6.2.3.1 Host Telemetry Buffering

IRD1394S005430 The Host shall provide buffering for those periods of time where the host would otherwise require instantaneous data rates above the contract specified peak rate so as to comply with section 3.2.6.2.1. [Host]

IRD1394S005440 The Host shall include in their buffer sizing sufficient space to handle (potential asynchronous communication) bus arbitration latency totaling 500 milliseconds per second for up to two contiguous seconds so as not to lose data when the 1394 data bus throttles data transmission per IRD1394S005450. [Host]

IRD1394S005450 The spacecraft shall accept data from each host at its contract specified peak data rate over any one-second interval such that data available for transmission by a host is accepted onto the 1394 bus with a delay not to exceed the following requirement IRD1394S005460, where one or more CCSDS packets of data exist in a buffer waiting for the 1394 bus to grant access for transmission: [SC]

IRD1394S005460 Delay between data becoming available for transmission (placed in the buffer) to the start of data transmission onto the 1394 bus shall be governed by the following equation: [SC, Host] *Requirement must be verified by SC for maximum delay and by Host for compliance condition in buffer sizing.*

$t \le T + S/DR$ where

t = Delay between data becoming available for transmission (placed in the buffer) to start of data transmission onto the 1394 bus

S = the size of the data waiting for transmission ahead of the specific data whose delay is to be calculated

DR = peak data rate on contract for the host (Kbps)

t = 500 milliseconds 60% of the time (nominal) or 1.0 seconds 99.999999% of the time (maximum). Examples are shown in Table 3.2.6-1. [SC] *This is an instantaneous calculation. For a block buffer where all data is made available in a single lump it may be used to calculate the time to the last CCSDS packet being emptied. For a FIFO type buffer it may be used to calculate a running delay at each instant a new CCSDS packet is added to the buffer.*

Table 3.2.6-1 1394 Data Throttling Behavior

Contracted data rate = DR			
Data	Size of Data in Bits	Delay to First bit of Data Transmission	
		Nominal (ms)	Maximum (ms)
CCSDS Packet 1	L	500	1000
CCSDS Packet 2	M	500 + (L/DR)	1000 + (L/DR)
CCSDS Packet 3	N	500 + ((L+M)/DR)	1000 + ((L+M)/DR)
CCSDS Packet 4	P	500 + ((L+M+N)/DR)	1000 + ((L+M+N)/DR)

3.2.6.2.3.2 Host Telemetry Data Transfers

IRD1394S005470 A host shall queue up single whole CCSDS packets where each queue pointer points to a single CCSDS packet. [Host]

IRD1394S005472 A host with any data ready to be sent from the application layer shall maintain data in the 1394-driver queue such that the driver is only waiting on the 1394 bus to grant access. [Host] *Any starvation-induced loss of bandwidth is allocated to the peak data rate budget on contract to the host.*

IRD1394S005476 The host shall provide sufficient burst rate communication and communication priority between buffers containing data to be sent and the NI link layer buffers to keep up with the maximum 1394 data rate. [Host]

IRD1394S005478 Host application layer software shall initiate the sending of any specific data to the driver only once. [Host]

3.2.6.2.4 Telemetry Formatting

IRD1394S005480 Telemetry packets shall all be formatted as CP_PDU source packets per CCSDS 701.0-B-2 and the figures for the specific packet types shown in Table 3.2.6-2. [Host, SC]

IRD1394S005490 The length of CCSDS Telemetry packets shall be greater than 16,384 bytes or the total size of the APID whichever is less. [Host] *The purpose of this requirement is to prevent a host from subdividing already small packets into segmented packets.*

Table 3.2.6-2 is intended to be superset of the formats that might be used. It does not require that all formats be used. If there are additional format types desired they may be added to the Host ICD following agreement by the spacecraft contractor who may also choose to add the new type to the superset listed in the IRD.

Table 3.2.6-2 includes telemetry packet types, with size constraints, that may consist of segmented CCSDS packets. If a packet does not have a segmented format shown it is intended to only be standalone.

Table 3.2.6-2 FT1394 Telemetry Types and Packet Sizes

User Spacecraft/ Ground	Telemetry Packet	Packet Length in Octets Including Headers	Required / Optional	Segment or Standalone	Figure
Spacecraft	Test Packets[a]	256	Required	Standalone	Figure 3.2.6-5
Ground	Memory Dump Packet	Maximum 65,507	Required	Both	Figure 3.2.6-1, Figure 3.2.6-2, Figure 3.2.6-3, Figure 3.2.6-4
Ground	Engineering data packets	Maximum 65,507	Required	Both	Figure 3.2.6-1, Figure 3.2.6-2, Figure 3.2.6-3, Figure 3.2.6-4
Ground	Housekeeping packets	Maximum 65,507	Required	Both	Figure 3.2.6-1, Figure 3.2.6-2, Figure 3.2.6-3, Figure 3.2.6-4
Ground	LEO&A Housekeeping packets	Maximum 32	Required	Standalone	Figure 3.2.6-5
Ground	Calibration packets	Maximum 65,507	Optional	Both	Figure 3.2.6-1, Figure 3.2.6-2, Figure 3.2.6-3, Figure 3.2.6-4
Ground	Dwell packets	Maximum 256	Optional	Both	Figure 3.2.6-1, Figure 3.2.6-2, Figure 3.2.6-3, Figure 3.2.6-4
Ground	Diagnostic packets	Maximum 65,507	Optional	Both	Figure 3.2.6-1, Figure 3.2.6-2, Figure 3.2.6-3, Figure 3.2.6-4
Ground	Science packets (Raw or Processed)	Maximum 65,507	Required	Both	Figure 3.2.6-1, Figure 3.2.6-2, Figure 3.2.6-3, Figure 3.2.6-4
Spacecraft	Telemetry monitoring packets	Maximum 32	Optional	Standalone	Figure 3.2.6-5

3.2.6.3 Commands and Memory Loads

3.2.6.3.1 Command and Memory Load Packet Length

[a] The Data field shall be “CCCCHEX”.

IRD1394S005500 The length of a single command or memory load packet shall be equal to or less than the maximum length per Table 3.2.6-3 [SC, Ground]

3.2.6.3.2 Documentation

IRD1394S005510 All Host commands and memory load packets shall be as documented in the Host ICD. [Host]

3.2.6.3.3 Commands and Memory Loads Transfer

3.2.6.3.3.1 Telecommand Maximum Rate

IRD1394S005520 Each Host shall maintain all functionality within a maximum Host uplink command and memory load rate equal to 20.48 Kbps for 6 minutes or a total uplink capacity per orbit of 7.382 megabits. [Host]

IRD1394S005530 All Telecommand and memory load data rate or other operational constraints shall be as documented in the Host ICD. [Host]

IRD1394S005540 The spacecraft shall transfer any currently stored commands from the spacecraft on-board computer to the Host at the time tagged to the command. [SC]

IRD1394S005550 The spacecraft shall transfer any commands received from a ground terminal within 1 second after the CCSDS packet is complete. [SC]

3.2.6.3.3.2 Spacecraft Generated Telecommands and Memory Loads

IRD1394S005600 Hosts shall be capable of receiving commands generated by the spacecraft with a unique APID for each memory load and command, where the memory load may be segmented with interleaved commands. [Host]

3.2.6.3.3.3 Telecommand Interval

IRD1394S005610 Each Host shall be capable of accepting a maximum combined command and memory load rate as specified in 3.2.6.3.3.1. [Host]

3.2.6.3.3.4 Ground Generated Telecommands and Memory Loads

IRD1394S005620 Hosts shall be capable of receiving commands generated by the ground with a unique APID for each memory load and command, where the memory load may be segmented with interleaved commands. [Host]

3.2.6.3.3.5 Spacecraft/Ground Memory Load Authority

IRD1394S005630 Simultaneous receipt of ground terminal generated memory loads and spacecraft generated memory loads shall result in only the ground memory load being executed. [Host except root node] Spacecraft/Ground Telecommand Authority

IRD1394S005640 Simultaneous receipt of ground terminal generated Telecommands and spacecraft generated Telecommands shall result in both Telecommands being executed. [SC, Ground]

3.2.6.3.3.6 Telecommand/Memory Load Authority

IRD1394S005650 Simultaneous receipt of Telecommands and memory loads shall result in both Telecommands and memory loads being executed. [Host]

3.2.6.3.4 Telecommand/Memory Load Data Transfer Process

3.2.6.3.4.1 Large Uplink Protocol

IRD1394S005700 Hosts shall be capable of accepting uplink Data Sets, including segmented commands and segmented loads where there may be other commands and time delays as long as one (1) second inserted between the CCSDS Packet Segments that comprise the CCSDS Packet Set. [Host]

IRD1394S005710 Hosts shall detect a time delay greater than specified in IRD1394S005700 above between receipts of CCSDS Packet Segments and as a result terminate the load or command. [Host] *This does not conflict with 3.2.6.3.3.1. It forces CCSDS segmented packets to take less than the orbital link opportunity.*

IRD1394S005720 All subsequent CCSDS packets that are part of a terminated CCSDS Packet Set shall be dropped without execution. [Host]

3.2.6.3.4.2 Partial Packets

IRD1394S005730 The spacecraft shall drop incomplete CCSDS packets prior to initiating transfer to the destination. [SC]

IRD1394S005740 A Host receiving a partial packet shall drop the packet and indicate the error in telemetry. [Host]

3.2.6.3.4.3 Partial CCSDS Packet Sets

IRD1394S005750 The spacecraft shall forward to the Host all CCSDS Packets as they are received without regard to CCSDS Packet Segmentation. [SC]

IRD1394S005760 Each CCSDS packet transfer shall be a separate operation. [SC]

IRD1394S005770 The first packet segment of a multi-segmented CCSDS packet containing a command or memory load shall contain the number of CCSDS packet segments in the secondary header per Figure 3.2.6-6 . [SC, Gnd] *Standalone (un-segmented) packet transfers are shown in Figure 3.2.6-9 .*

IRD1394S005780 The Host shall determine the number of words (W = 2 octets, 16 bits) from the primary header and the number of packet segments (P), if more than one, from the secondary header. [Host]

For a standalone CCSDS packet, P has an implied value of 0.

IRD1394S005790 The number of packets in the packet-set to be received shall be $P+1$. [Host] IRD1394S005800 A new packet shall not begin until the last packet is complete. [SC]

IRD1394S005810 A new CCSDS packet or packet set, using the same APID, shall not be initiated prior to the completion of another CCSDS packet or packet set. [Host]

IRD1394S005820 The Host shall be capable of receiving and processing a CCSDS packet with a different APID in the middle of the transfer of another CCSDS packet set. [Host]

IRD1394S005830 The Host shall be capable of supporting partial memory loads over multiple contacts. [Host]

IRD1394S005840 The Host shall detect the initiation of a new CCSDS packet or packet set, using the same APID, prior to the completion of another CCSDS packet set. Detection shall cause all packet segments associated with the as yet unfinished CCSDS packet set to be abandoned. [Host]

IRD1394S005850 Command packets taking more than 1 second to complete shall be abandoned and an error shall be indicated in telemetry of the data-receiving Host. [Host]

IRD1394S005860 Abandoned CCSDS packet segments and/or rejected CCSDS packets due to errors shall be indicated in telemetry of the data-receiving Host. [Host]

IRD1394S005870 The Host shall detect the complete reception of a packet, packet segment, and CCSDS packet set by using the header data and counting octets. [Host]

3.2.6.3.5 Command Constraint

IRD1394S005890 All Host command constraints shall be documented in the ICD. [Host]

3.2.6.3.6 Telecommand Formatting

IRD1394S005900 Telecommand packets shall all be formatted as CP_PDU source packets per CCSDS 701.0-B-2 and the figures for the specific packet types shown in Table 3.2.6-3. [Host]

Table 3.2.6-3 Telecommand Types and Packet Sizes

Source Spacecraft/ Ground	Telecommand Packet	Packet Length in CCSDS octets Including Headers	Required / Optional	Segment or Standalone	Figure
Spacecraft	Time-of-Day Broadcast	Fixed 14 minimum	Required	Standalone	Figure 3.2.6-10
Both	Command	Maximum 256	Required	Both	Figure 3.2.6-6 , Figure 3.2.6-7 , Figure 3.2.6-8 , Figure 3.2.6-9
Both	Memory Load	Maximum 1024[a]	Required	Both	Figure 3.2.6-6 , Figure 3.2.6-7 , Figure 3.2.6-8 , Figure 3.2.6-9

[a] The maximum packet size is defined by the source of the packet. Ground packets must not exceed 1017 CCSDS octets in size due to the Telecommand frame restrictions. SC sourced packets may be allowed to reach 1024 CCSDS octets.

First Source Packet of a Segmented Message (PSC=01)										
Primary Header							Secondary Header			DATA FIELD
Packet Identification				Packet Sequence Control (PSC)		Packet Length				
000	0	1	XXXXXXXXXXX (11bits)	01	XXXXXXXXXXXXXX (14bits)	XXXXXXXXXXXXXXXX (16bits)	8 Octets (64 bits)	XXXXXXXX (8bits)	XXXXXXXX (8bits)	Variable Octets
Fixed by CCSDS	Type is Telemetry	Secondary Header	APID Assigned to this data	Packet	Sequence # 00 = Middle 01 = First 10 = Last 11 = Standalone	Length of this specific packet in octets = Secondary Header plus Data Fields-1	CCSDS CDS Level 1 Time of Day Start of data	PSC Type = 01 Number of Packet Segments - 1	Spare	

Figure 3.2.6-1 Segmented Mission Data &Telemetry Packet – First Segment

Middle Source Packet of a Segmented Packet Set (PSC=00)							
Primary Header							DATA FIELD
Packet Identification				Packet Sequence Control (PSC)		Packet Length	Data
000	0	0	XXXXXXXXXXX (11bits)	00	XXXXXXXXXXXXXX (14bits)	XXXXXXXXXXXXXXXX (16bits)	Variable Octets
Fixed by CCSDS	Type is Telemetry	Secondary Header	APID Assigned to this data	Packet	Sequence # 00 = Middle 01 = First 10 = Last 11 = Standalone	Length of this specific packet in octets = Secondary Header plus Data Fields-1	

Figure 3.2.6-2 Segmented Mission Data & Telemetry Packet – Middle Segment

Last Source Packet of a Segmented Packet Set (PSC=10)							
Primary Header							DATA FIELD
Packet Identification				Packet Sequence Control (PSC)		Packet Length	Data
000	0	0	XXXXXXXXXXX (11bits)	**10**	XXXXXXXXXXXXXX (14bits)	XXXXXXXXXXXXXXXX (16bits)	Variable Octets
Fixed by CCSDS	Type is Telemetry	Secondary Header	APID Assigned to this data	Packet	Sequence # 00 = Middle 01 = First 10 = Last 11 = Standalone	Length of this specific packet in octets = Secondary Header plus Data Fields-1	

Figure 3.2.6-3 Segmented Mission Data & Telemetry Packet – Last Segment

Only Source Packet of a Non-segmented Packet (PSC=11)								
Primary Header							Secondary Header	DATA FIELD
Packet Identification				Packet Sequence Control (PSC)		Packet Length		
000	0	1	XXXXXXXXXXX (11bits)	**11**	XXXXXXXXXXXXXX (14bits)	XXXXXXXXXXXXXXXX (16bits)	8 Octets	Variable Octets
Fixed by CCSDS	Type is Telemetry	Secondary Header	APID Assigned to this data	Packet	Sequence # 00 = Middle 01 = First 10 = Last 11 = Standalone	Length of this specific packet in octets = Secondary Header plus Data Fields-1	CCSDS CDS Level 1 Time of Day Start of data	

Figure 3.2.6-4 Non-Segmented Mission Data & Telemetry Packet – Standalone Segment

Standalone Never Segment Packet (PSC=11)							
Primary Header							DATA FIELD
Packet Identification				Packet Sequence Control (PSC)		Packet Length	Data
000	0	0	XXXXXXXXXXX (11bits)	**11**	XXXXXXXXXXXXXX (14bits)	XXXXXXXXXXXXXXXX (16bits)	Variable Octets
Fixed by CCSDS	Type is Telemetry	Secondary Header	APID Assigned to this data	Packet	Sequence # 00 = Middle 01 = First 10 = Last 11 = Standalone	Length of this specific packet in octets = Secondary Header plus Data Fields-1	

Figure 3.2.6-5 LEO&A, Test, and Telemetry Monitor Packet Format

First Source Packet of a Segmented Telecommand Packet Set (PSC=01)									
Primary Header							Secondary Header		DATA FIELD
Packet Identification				Packet Sequence Control (PSC)		Packet Length			
000	1	1	XXXXXXXXXXX (11bits)	01	XXXXXXXXXXXXXX (14bits)	XXXXXXXXXXXXXXXX (16bits)	XXXXXXXX (8bits)	XXXXXXXX (8bits)	Variable Octets
Fixed by CCSDS	Type is Command	Secondary Header	APID Assigned to this data	Packet	Sequence #	Length of this specific packet in octets = Secondary Header plus Data Fields-1	PSC Type = 01 Number of Packet Segments - 1	Spare	
				00 = Middle 01 = First 10 = Last 11 = Standalone					

Figure 3.2.6-6 Telecommand Segmented Data Packet – First Segment

Middle Source Packet of a Segmented Telecommand Packet Set (PSC=00)							
Primary Header							DATA FIELD
Packet Identification				Packet Sequence Control (PSC)		Packet Length	
000	1	0	XXXXXXXXXXX (11bits)	00	XXXXXXXXXXXXXX (14bits)	XXXXXXXXXXXXXXXX (16bits)	Variable Octets
Fixed by CCSDS	Type is Command	Secondary Header	APID Assigned to this data	Packet	Sequence #	Length of this specific packet in octets = Secondary Header plus Data Fields-1	
				00 = Middle 01 = First 10 = Last 11 = Standalone			

Figure 3.2.6-7 Telecommand Segmented Data Packet – Middle Segment

Last Source Packet of a Segmented Telecommand Packet Set (PSC=10)							
Primary Header							DATA FIELD
Packet Identification				Packet Sequence Control (PSC)		Packet Length	
000	1	0	XXXXXXXXXXX (11bits)	**10**	XXXXXXXXXXXXXX (14bits)	XXXXXXXXXXXXXXXX (16bits)	Variable Octets
Fixed by CCSDS	Type is Command	Secondary Header	APID Assigned to this data	Packet 00 = Middle 01 = First 10 = Last 11 = Standalone	Sequence #	Length of this specific packet in octets = Secondary Header plus Data Fields-1	

Figure 3.2.6-8 Telecommand Segmented Data Packet – Last Segment

Standalone Telecommand Packet (PSC=11)								
Primary Header							Secondary Header is Optional	DATA FIELD
Packet Identification				Packet Sequence Control (PSC)		Packet Length		
000	1	0/1	XXXXXXXXXXX (11bits)	**11**	XXXXXXXXXXXXXX (14bits)	XXXXXXXXXXXXXXXX (16bits)		Variable Octets
Fixed by CCSDS	Type is Command	Secondary Header	APID Assigned to this data	Packet 00 = Middle 01 = First 10 = Last 11 = Standalone	Sequence #	Length of this specific packet in octets = Secondary Header plus Data Fields-1		

Figure 3.2.6-9 Telecommand Non-Segmented Data Packet – Standalone Segment

14 Octets + Data Field if any								
Primary Header (6 octets)							Secondary Header	Data
Packet Identification				Packet Sequence Control (PSC)		Packet Length	Time of Day	Unused
000	0	1	XXXXXXXXXXX (11bits)	**11**	XXXXXXXXXXXXXX (14bits)	XXXXXXXXXXXXXXXX (16bits)	8 Octets	Unused
Fixed by CCSDS	Type is Telemetry	Secondary Header	APID Assigned to this data	Packet	Sequence #	Length of this specific packet in octets = Secondary Header plus Data Fields-1	CCSDS CDS Level 1 Time of Day Start of data	Unused
				00 = Middle 01 = First 10 = Last 11 = Standalone				

Figure 3.2.6-10 Broadcast Time-of-Day Data Packet Format

3.2.6.4 Broadcast Data

IRD1394S005910 All FT1394 nodes shall receive broadcast FT1394 messages. [SC, Host]

IRD1394S005920 Time-of-Day CCSDS packet shall be a Broadcast message. [SC]

IRD1394S005930 Broadcast shall be repeated on bus B (inactive bus) as necessary to reach all hosts. [SC, Host]

3.2.6.5 Mission Science Data to RDRs

IRD1394S005940 Raw Data Records (RDRs) shall be assembled by ground processing and not by the Host. [Ground]

3.2.6.5.1 Mission Data Content

IRD1394S005950 All observed science data to be included in the downlink shall be contained in science data packets. [Host]

3.2.6.5.2 Engineering (Auxiliary) RDR Data

IRD1394S005960 All auxiliary data required for inclusion with observed science data to generate an RDR, but not including ephemeris data, attitude data, shall be contained in a separate data packet type conforming to the engineering telemetry format. [Host]

3.2.6.5.3 Spacecraft Ephemeris Data

IRD1394S005970 The Host except for spacecraft shall not put ephemeris data in any data packets. [Host]

3.2.6.6 Error Handling

IRD1394S005980 The loss of any part of a CCSDS packet shall cause the loss of the entire CCSDS packet. [Host]

3.2.6.7 Fault Management

3.2.6.7.1 Automatic Data Retry

IRD1394S200400 The host application layer shall not retry data transmissions except during network manager diagnostics. [Host]

IRD1394S200405 Each host shall transmit data to the specified IP for each APID as loaded by the network manager [Host]

IRD1394S200407 The Network Manager shall be capable of sending data to any IP address within the system. [NM]

IRD1394S200410 The network manager shall manage the APID to IP tables in each host. [NM]

IRD1394S200415 The driver shall determine which bus, Bus A or Bus B, the data shall be routed to based upon the IP address. [Driver]

3.2.6.7.2 Bus Reconfiguration

IRD1394S200420 The Ground shall override the Network Manager's designation of the active bus (A or B) or sections thereof. [Ground]

IRD1394S200430 Only the Network Manager shall reconfigure the bus. [NM]

IRD1394S200440 The Network Manager shall default at power reset to the A bus. [NM]

IRD1394S200450 The Network Manager shall activate the B bus upon detection of a failure on the A bus and diagnose the A bus. [NM]

IRD1394S200460 The Root shall designate segments of both A and B buses. [NM]

IRD1394S200470 The Host shall receive commands on either bus A or bus B. [Host]

IRD1394S200472 The Network Manger shall command each host data-types to IP relationships. [NM]

IRD1394S200474 Each Host shall have a default set of data-types to IP relationships. [Host]

IRD1394S200476 The Host shall accept commands to load a new set of data-types to IP relationships. [Host]

IRD1394S200480 A Physical Layer response output from a Host shall be on the bus on which the Physical Layer command was received. [NI] *Changed and added 81,82 to clarify what types of command produce output on which bus.*

IRD1394S200481 Any Driver response output from a Host shall be on the bus on which the Driver received the command. [Driver]

IRD1394S200482 All application layer output from a Host shall be on the bus designated by the data-types to IP relationship previously. [Host]

IRD1394S200490 The Host, except for the Root Node, shall only output on the commanded 1394 bus except for pings per 3.2.6.7.3. [Host]

3.2.6.7.3 Fault Detection Ping

IRD1394S200500 The Host shall contain a response mechanism to an IP "ping" indicating that the Host is functioning properly. [Host]

IRD1394S200510 The Network Manager shall periodically IP ping each Host to determine its health. [NM]

IRD1394S200530 An IP Ping response failure, as defined in network fault management, shall activate network fault management. [NM]

IRD1394S200531 The driver shall be capable of sending a broadcast IP Ping. [Driver]

IRD1394S200532 The driver shall receive and respond to a broadcast IP Ping. [Driver]

3.2.6.7.4 Fault Telemetry

IRD1394S200535 A host receiving a CCSDS packet shall count and telemeter CCSDS packets dropped due to detected errors. [Host]

IRD1394S200540 Hosts shall telemeter the loss of Bus A TOD, Bus B TOD. [Host]

IRD1394S200545 Hosts shall telemeter host 1394 initialization caused by 1394 cable power application subsequent to host main power application. [Host]

IRD1394S200550 Hosts shall telemeter host 1394 initialization caused by a command. [Host]

IRD1394S200555 Hosts shall telemeter which Bus A or Bus B they are configured to send data on. [Host]

IRD1394S200556 The driver shall count and make available through an API to the host errors in 1394 physical packets. [Driver]

IRD1394S200557 The host shall telemeter the driver count data representing physical packet errors. [Host]

IRD1394S200558 The spacecraft shall continue to send time of day packets to the sensors except for conditions that inhibit 1394 communication. [SC] *The time of day may not be correct but it shall still be sent.*

3.2.6.7.5 Host Fault Management

Fault management within a host is entirely based on the detection of TOD packets missing. Detection of problems on Bus A or on Bus B instigates actions relating to that bus without changing the ability to communicate using the other bus. To this end there are three event counters TOD_Loss_BusA_Cntr, TOD_Loss_BusB_Cntr, TOD_Loss_BusAB_Cntr that count the detection events for Bus A, Bus B, and both within a single 1 second interval respectively. The TOD_Loss_BusAB_Cntr counter herein is compliant with the GIID requirement to check for missing TOD and associated transfer to safe-mode. Variable names included herein are examples and allow following the thread of requirements. There is no requirement for these names to be used.

3.2.6.7.5.1 Host 1394 Initialization

IRD1394S201000 Section 3.2.6.7.5 shall apply in all modes except OFF Mode and Survival Mode. [Host except the root node] {T

IRD1394S201005 Host 1394 Initialization and re-initialization of Bus A or Bus B shall not affect the other bus (the bus not being initialized or re-initialized). [Host]

IRD1394S201010 On power-up TOD_Loss_BusA_Cntr, TOD_Loss_BusB_Cntr, TOD_Loss_BusAB_Cntr counters shall be reset to zero. [Host except the root node] {T}

IRD1394S201020 The host, except the root node, shall reset to zero the TOD_Loss_BusA_Cntr upon receipt of a TOD packet via Bus A or transition to Safe-Mode. [Host except the root node] {T}

IRD1394S201030 The host, except the root node, shall reset to zero the TOD_Loss_BusB_Cntr upon receipt of a TOD packet via Bus B or transition to Safe-Mode. [Host except the root node] {T}

IRD1394S201035 The host, except the root node, shall reset to zero the TOD_Loss_BusAB_Cntr upon detecting of a TOD packet via Bus A or Bus B. [Host except the root node] {T}

IRD1394S201040 The Driver, as a result of a 1394-driver initialization or 1394-driver re-initialization API call, shall perform initialization of 1394 hardware and software correcting for hardware errata as noted in D36381 section 5. [Driver] {A}

IRD1394S201050 The driver shall as a result of a Host 1394 Initialization or re-initialization API call clear all 1394 software stacks and queues, and, all hardware buffers of in-process and previously queued data transmissions. [Driver] {A}

IRD1394S201060 The driver, as a result of a Host 1394 Initialization or re-initialization API call, shall not initiate any packet to the LLC until receipt of host data to be sent via an API call. [Driver] {A}

IRD1394S201065 The driver shall only instigate PHY register reads or writes while performing initialization or re-initialization related functions. [Driver]

3.2.6.7.5.2 Detection

IRD1394S202000 The host, except the root node, shall detect the loss of a 1-second periodic time-of-day packet on Bus A. [Host except the root node] {I}

IRD1394S202010 The host, except the root node, shall detect the loss of a 1-second periodic time-of-day packet on Bus B. [Host except the root node] {I}

IRD1394S202030 The host, except the root node, shall detect the loss of a 1-second periodic time-of-day packet on both Bus A and Bus B during the same one-second period. [Host except the root node]{I}

IRD1394S202040 The host shall detect 1394 bus reset events. [Host] {I}

IRD1394S202020 The Driver shall have the ability to communicate 1394 bus-reset events to the host. [Driver] {T}

3.2.6.7.5.3 Response

3.2.6.7.5.3.1 TOD Loss Counters

IRD1394S203000 The host, except the root node, shall count 1-second periodic time-of-day packet loss events. [Host except the root node] {I}

IRD1394S203010 The Host, except the root node, shall have separate counters for Bus A (TOD_Loss_BusA_Cntr) and Bus B (TOD_Loss_BusB_Cntr) for 1-second periodic time-of-day packet loss events. [Host except the root node] {I}

IRD1394S203020 The host, except the root node, shall count events where 1-second periodic time-of-day packet loss is detected on both Bus A and Bus B (TOD_Loss_BusAB_Cntr) during the same second. [Host except the root node] {I}

3.2.6.7.5.4 Process - TOD Loss On a Single Bus

IRD1394S204000 The counter (TOD_Loss_BusA_Cntr or TOD_Loss_BusB_Cntr) threshold for initiating action relative to the related bus shall be capable of being set by command. [Host except the root node] {T}

IRD1394S204010 The default value for the counter (TOD_Loss_BusA_Cntr and TOD_Loss_BusB_Cntr) threshold for initiating action relative to the related bus shall be 10. [Host except the root node] {T}

IRD1394S204030 The host, except the root node, shall, upon a TOD_Loss_BusA_Cntr or TOD_Loss_BusB_Cntr event counter equaling its threshold, perform a Host 1394 re-initialization, on the bus whose threshold was reached. [Host except the root node] {T}

IRD1394S204070 The host, except the root node, shall perform this process (3.2.6.7.5.4) in both Safe and Normal modes. [Host except the root node] {T}

3.2.6.7.5.5 Process - TOD Loss On a Both Buses

IRD1394S205000 The counter (TOD_Loss_BusAB_Cntr) threshold for taking action shall be capable of being set by command. [Host except the root node] {T}

IRD1394S205010 The host, except the root node, upon TOD_Loss_BusAB_Cntr being equal to the threshold shall transition itself to Safe Mode. [Host except the root node] {T}

IRD1394S205020 The host, except the root node, shall perform this process (3.2.6.7.5.5) in Activation (defined to be the transitional mode upon power turn-on) and all other Normal modes. [Host except the root node] {T}

IRD1394S205030 The default value for the counter (TOD_Loss_BusAB_Cntr) threshold for initiating action shall be 12. [Host except the root node] {T} *This counter is independent of the other counters for Bus A and Bus B*

3.2.6.7.5.6 Deleted

3.2.6.7.5.6.1 System Reset Responses

IRD1394S206120 A Host on the bus shall respond to the application or re-application of primary power by performing a PCI Bus-Reset. [Host] {T}

IRD1394S206150 The network Manager shall respond to a detected ring on the bus by breaking the 1394 ring using the Port Disable command and performing a software Bus-Reset. [NM] {T}

IRD1394S206160 The network Manager shall respond to failed ICMP pings on a host for 3 sequential pings on a single host by performing a software Bus-Reset once. [NM] {T}

IRD1394S206165 The network Manager shall respond to 3 sequential failed ICMP pings on a bus by performing a software Bus-Reset once. [NM] {T}

IRD1394S206170 The network Manager shall respond to a real time or stored command for bus reset by performing a software Bus-Reset. [NM] {T}

3.2.6.7.5.6.2 Deleted

3.2.6.7.5.6.3 Driver Reset Response

IRD1394S206300 Following the completion of a 1394 Bus-Reset, the driver shall be capable of transmitting and receiving on the 1394 Bus using the UDP/IP over 1394 API calls. [Driver] {T}

3.2.6.7.5.6.4 Deleted

3.2.7 UDP Ports

IRD1394S207000 The Driver shall be capable of receiving data from and sending data to a total of 32 simultaneously open UDP Ports shared between both 1394 Network Interfaces. [Driver] {I}

IRD1394S207010 The Host shall use UDP Port numbers between 10000 through 10031. [Host] {I}

IRD1394S207020 The Host shall receive UDP Port numbers with the IP addresses as part of a table load. [Host] {T}

IRD1394S207030 The default UDP port numbers shall be as defined in Table 3.2.8-4. [Host] {T} *This table is built using the Port rules in Table 3.2.8-1 and the Data flow routing rules in Table 3.2.8-3*.

3.2.8 IP Address Table

IRD1394S200560 Each host shall contain a default table that maps data-types to destination IP addresses including destination Port Numbers.[Host] {I}

IRD1394S200565 The data-types to IP table shall relate each of the packet types used to a unique Bus A destination and a unique Bus B destination. [Host] {I}

IRD1394S200575 The Host shall accept an update to the current data-types to IP table as a Table load. [Host] {T}

IRD1394S200580 The default IP Addresses shall be as defined in Table 3.2.8-4 [Host] {T} *Table 3.2.8-2 is the basic table of IP addresses as allocated to the various hosts, and the root as they are used for both bus A and Bus B*.

IRD1394S200585 NPOESS data routing shall be as defined in Table 3.2.8-3. [Gnd] {I}

IRD1394S200590 The Host shall replace the active data-types to IP relationships in the table with those contained in the table load specified in section 3.2.12. [NM] {T}

Table 3.2.8-1 Port Rules

Port Number	**Port Function**
10001	CMD & Memory Load
10031	Broadcast packets including TOD Network CMD & response – bi-directional
10004	Housekeeping Packets LEO&A packets
10008	Telemetry – All telemetry Not elsewhere listed in this table
10016	Telemetry packets that require processing by Spacecraft except TMON. (*Includes all LRD packets*)
10015	PSP routed sensor Telemetry except HK and TMON which follow HK and TMON port rules
10002	TMON

Table 3.2.8-2 Default IP Addressing

		Bus A	Bus B
SCP	P	172:015:001:006	172:016:001:006
SCP	R	172:015:001:007	172:016:001:007
DSU	P	172:015:001:004	172:016:001:004
DSU	R	172:015:001:005	172:016:001:005
PSP	P	172:015:001:002	172:016:001:002
PSP	R	172:015:001:003	172:016:001:003
VIIRS	P	172:015:001:112	172:016:001:112
VIIRS	R	172:015:001:113	172:016:001:113
CrIS	P	172:015:001:122	172:016:001:122
CrIS	R	172:015:001:123	172:016:001:123
CMIS	P	172:015:001:132	172:016:001:132
CMIS	R	172:015:001:133	172:016:001:133
Broadcast	X	172:015:255:255	172:016:255:255

Table 3.2.8-3 Data-Types to IP Address Relationships

		Tmon	HK	Eng	Science	LRD	CAL	Diag	Dwell	CMDs	Broadcast
FROM		TO									
SCP-P	IP Address	NA	DSU	NA	NA	NA	NA	DSU	DSU	Any	Any
	Port Number	NA	Port	NA	NA	NA	NA	Port	Port	Port	Port
SCP-R	IP Address	NA	DSU	NA	NA	NA	NA	DSU	DSU	ALL	ALL
	Port Number	NA	Port	NA	NA	NA	NA	Port	Port	Port	Port
DSU-P	I IP Address	SCP	DSU	NA	NA	NA	NA	NA	NA	NA	NA
	Port Number	Port	Port	NA	NA	NA	NA	NA	NA	NA	NA
DSU-R	IP Address	SCP	DSU	NA	NA	NA	NA	NA	NA	NA	NA
	Port Number	Port	Port	NA	NA	NA	NA	NA	NA	NA	NA
PSP (psp related data only)-P	IP Address	SCP	DSU	NA	NA	NA	NA	DSU	DSU	NA	NA
	Port Number	Port	Port	NA	NA	NA	NA	Port	Port	NA	NA
PSP (psp related data only)-R	IP Address	SCP	DSU	NA	NA	NA	NA	DSU	DSU	NA	NA
	Port Number	Port	Port	NA	NA	NA	NA	Port	Port	NA	NA
VIIRS-P	IP Address	SCP	DSU	DSU	DSU	DSU	DSU	DSU	DSU	NA	NA
	Port Number	Port	Port	Port	Port	Port	Port	Port	Port	NA	NA
VIIRS-R	IP Address	SCP	DSU	DSU	DSU	DSU	DSU	DSU	DSU	NA	NA
	Port Number	Port	Port	Port	Port	Port	Port	Port	Port	NA	NA
CrIS-P	IP Address	SCP	DSU	DSU	DSU	DSU	DSU	DSU	DSU	NA	NA
	Port Number	Port	Port	Port	Port	Port	Port	Port	Port	NA	NA
CrIS-R	IP Address	SCP	DSU	DSU	DSU	DSU	DSU	DSU	DSU	NA	NA
	Port Number	Port	Port	Port	Port	Port	Port	Port	Port	NA	NA
CMIS-P	IP Address	SCP	DSU	DSU	DSU	DSU	DSU	DSU	DSU	NA	NA
	Port Number	Port	Port	Port	Port	Port	Port	Port	Port	NA	NA
CMIS-R	IP Address	SCP	DSU	DSU	DSU	DSU	DSU	DSU	DSU	NA	NA
	Port Number	Port	Port	Port	Port	Port	Port	Port	Port	NA	NA
1553 Subnet Sensors	IP Address	SCP	DSU	DSU	DSU	DSU	DSU	DSU	DSU	NA	NA
	Port Number	Port	Port	Port	Port	Port	Port	Port	Port	NA	NA
Bit Service Sensor	IP Address	NA	NA	NA	DSU	DSU	NA	NA	NA	NA	NA
	Port Number	NA	NA	NA	Port	Port	NA	NA	NA	NA	NA

Table 3.2.8-4 Data Types to IP Address Relationship Deafult

FROM		TMON	HK	Eng	Science	LRD	CAL	Diag	Dwell	CMDs	Broadcast
		TO									
SCP-P	IP Address	NA	172:15:1:4	NA	NA	NA	NA	172:15:1:4	172:15:1:4	Any	Any
	Port Number	NA	10004	NA	NA	NA	NA	10008	10008	Port	Port
SCP-R	IP Address	NA	172:15:1:4	NA	NA	NA	NA	172:15:1:4	172:15:1:4	ALL	ALL
	Port Number	NA	10004	NA	NA	NA	NA	10008	10008	Port	Port
DSU-P	I IP Address	172:15:1:6	172:15:1:4	NA	NA	NA	NA	NA	NA	NA	NA
	Port Number	10002	10004	NA	NA	NA	NA	NA	NA	NA	NA
DSU-R	IP Address	172:15:1:6	172:15:1:4	NA	NA	NA	NA	NA	NA	NA	NA
	Port Number	10002	10004	NA	NA	NA	NA	NA	NA	NA	NA
PSP (psp related data only)-P	IP Address	172:15:1:6	172:15:1:4	NA	NA	NA	NA	172:15:1:4	172:15:1:4	NA	NA
	Port Number	10002	10004	NA	NA	NA	NA	10008	10008	NA	NA
PSP (psp related data only)-R	IP Address	172:15:1:6	172:15:1:4	NA	NA	NA	NA	172:15:1:4	172:15:1:4	NA	NA
	Port Number	10002	10004	NA	NA	NA	NA	10008	10008	NA	NA
VIIRS-P	IP Address	172:15:1:6	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	NA	NA
	Port Number	10002	10004	10008	10008	10016	10008	10008	10008	NA	NA
VIIRS-R	IP Address	172:15:1:6	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	NA	NA
	Port Number	10002	10004	10008	10008	10016	10008	10008	10008	NA	NA
CrIS-P	IP Address	172:15:1:6	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	NA	NA
	Port Number	10002	10004	10008	10008	10016	10008	10008	10008	NA	NA
CrIS-R	IP Address	172:15:1:6	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	NA	NA
	Port Number	10002	10004	10008	10008	10016	10008	10008	10008	NA	NA
CMIS-P	IP Address	172:15:1:6	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	NA	NA
	Port Number	10002	10004	10008	10008	10016	10008	10008	10008	NA	NA
CMIS-R	IP Address	172:15:1:6	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	NA	NA
	Port Number	10002	10004	10008	10008	10016	10008	10008	10008	NA	NA
1553 Subnet Sensors	IP Address	172:15:1:6	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	NA	NA
	Port Number	10002	10004	10015	10015	10015	10015	10015	10015	NA	NA
Bit Service Sensor	IP Address	NA	NA	NA	172:15:1:4	172:15:1:4	NA	NA	NA	NA	NA
	Port Number	NA	NA	NA	10015	10015	NA	NA	NA	NA	NA

3.2.9 Packetization Summary

IRD1394S005990 Packetization shall occur at multiple levels from the application layer to the physical layer per Figure 3.2.9-1. [Host]

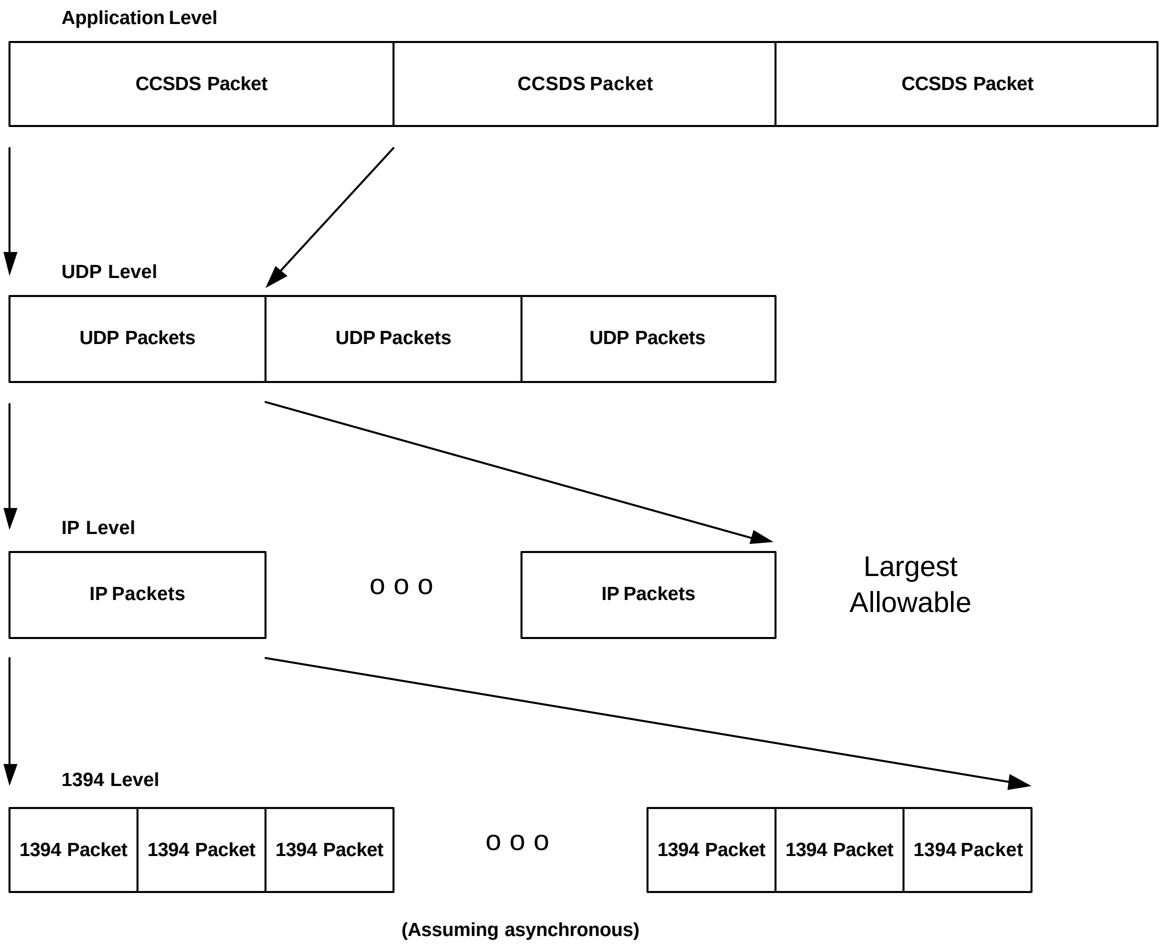

Figure 3.2.9-1 Hierarchical Packetization

3.2.10 Network Fault Management

IRD1394S200600 The Network Manager shall detect, diagnose and correct any failure on or in the bus that impacts mission success. [NM]

IRD1394S200620 The Network Manager shall detect, diagnose and correct any single failure on or in the bus that inhibits the ability for any Host to transfer data to or receive data from any other Host. [NM]

3.2.10.1 Network Diagnosis

IRD1394S200630 The Network Manager shall recover autonomously from any single fault on each 1394 bus where the faults may occur first on either bus A or Bus B. [NM]

IRD1394S200640 The Network Manager shall recover autonomously from any two faults on a single bus and with up to a single fault on the alternate bus given that the faults do not overlap common nodes where the faults may occur in any order. [NM]

IRD1394S200650 Once full performance has been recovered subsequent to the detection of a fault, the Network Manager shall identify the fault in the non-operational bus and recover functionality of all nodes that are either directly connected or indirectly connected through a working node to the Root Node. [NM]

IRD1394S200660 The spacecraft shall not autonomously switch any Host main power from off to on. [SC]

3.2.10.2 Fault Identification

IRD1394S200670 The FT1394 Network Manager shall detect a single failure has occurred anywhere in the operational bus (Bus A or Bus B). [NM]

IRD1394S200680 The Network Manager shall implement an algorithm to recover full performance through bus switching or bus rerouting within 11 seconds. [NM] *Allows 1 second for timing margin.*

IRD1394S200690 The Driver shall include an application IP ping response function to assist the Network Manager in detecting active nodes and node failures. [Driver]

3.2.10.2.1 Detection of Host Port Failure

IRD1394S200691 The host shall detect through loss of sequential Time-of-Day packets on a bus, the loss of node communication capability. [Host]

IRD1394S200692 Loss of TOD packet shall be detected when a TOD packet is not received before the end of a missing TOD Interval. [Host] {T}

IRD1394S200693 Missing TOD Intervals shall be $1.1 < t < 1.2$ seconds duration starting with the end of the previous missing TOD interval. [Host] {A}

IRD1394S200694 Receipt of TOD packet shall reset the missing TOD interval period to zero. [Host] {T}

3.2.10.2.2 Detection of System Failure

IRD1394S200695 The host shall detect loss of sequential Time-of-Day Packets on both buses. [Host]

IRD1394S200697 The driver shall make available to the host Time-of-Day packet from each bus along with an indication of the node receiving the data. [Driver]

3.2.10.3 Fault Isolation

IRD1394S200700 The Network Manager Node shall logically isolate faults on the FT1394 network. [NM]

IRD1394S200710 The Network Manager shall isolate faults on the FT1394 network maintaining communication with each Host. [NMManaged Network Reconfigurations

The Root should autonomously maintain the maximally operational system regardless of a single fault, order of fault occurrence, or nature of the fault occurring in any hardware or software that ultimately results in a bus reset or prevents the network manager from communicating on the network via either bus.

IRD1394S200730 In the case of a Bus-Reset the Network Manager shall repartition the bus to logically break the physical ring in the appropriate location to allow resumed operations. [NM]

IRD1394S200740 In the case where there has been more than one fault within a single bus or across the two buses in the FT1394 Serial bus system, the Network Manager shall reconfigure the bus such that the faults are isolated from the serial data chain and utilize the Bus A for the part of the network where the faults precluded access via the bus B and visa versa. [NM]

IRD1394S200750 Fault correction/reconfiguration shall autonomously resume normal operations even if it is not possible to recover specific node functionality due to multiple of failures. [NM]

IRD1394S200760 The spacecraft processor fault manager shall monitor the operational Network/Root-node combination. [SC]

IRD1394S200770 The spacecraft processor fault manager, upon detection of a fault in the Network/Root-node combination, shall reconfigure the spacecraft processor to the alternate Network/Root-node combination autonomously. [SC]

3.2.10.3.1 Suspend and Recover

IRD1394S200790 The Host shall operate through loss of any data due to unavailability of the network interface or network such that it resumes normal communications autonomously once network services have been restored. [Host]

If the network manager used port suspend for any purpose it should only suspend input ports of a node. The network manager should retain information related to suspend and resume

3.2.10.3.2 Deleted

3.2.10.3.3 Detection of Faults on Previously Suspended or Disabled PHY Ports

IRD1394S200970 The network manager shall disable all ports not used in the system. [NM]

3.2.11 Time-of-Day

The Time-of-Day CCSDS packet may contain a data field in addition to the secondary header TOD.

IRD1394S006000 The spacecraft shall communicate time-of-day once per second. [SC]

T-Field			
	Day	**msec of Day**	**μsec of msec**
Bits	16	32	16
Time Resolution of 1 μsec	0 to (2^{16}-1)	0 to 86,399,999	0 to 999

Figure 3.2.11-1 Time Code Format

3.2.11.1 Time Code Data and Format

IRD1394S006010 All Instances of time code data shall be spacecraft time presented in CCSDS Day segmented (CDS) time code format defined in CCSDS 301.0-B-2. [SC]

The time code data represents spacecraft time at the next occurrence of the Time-of-Day Pulse (i.e., at the tone the time will be. The Time-of-Day Pulse represents the tone.). [SC]

3.2.11.2 Time Code Effectivity

IRD1394S006020 The broadcast time shall become effective upon receipt of the Time-of-Day pulse that follows. [SC]

3.2.11.3 Time Code Data Epoch

IRD1394S006030 The Epoch shall be January 1, 1958. [SC]

3.2.11.4 Missing Time Code Data

IRD1394S006040 Hosts shall be capable of continued normal mode, until transfer to safe mode is effected, if the time code data is not received. [Host]

3.2.12 Commands

3.2.12.1 Host Application Layer Command

IRD1394S208000 Hosts, except the root node, shall accept, decode and appropriately respond to the following commands in Table 3.2.12-1. [Host except the root node] {T}

IRD1394S208010 The host shall document the exact format of each command in their command and telemetry dictionary or ICD. [Host] {T}

Table 3.2.12-1 Host Application Layer Commands

#	Command	Host Response	Qty Data Bits
2			
3	Clear Fault Log	The fault log and overwritten status are cleared. “1” equals clear action. “0” equals no action.	1

#	Command	Host Response	Qty Data Bits
4	Set TOD Safe Mode Threshold	Set the TOD algorithm threshold to N for going to Safe Mode	8
5	Set TOD Bus Initialize Threshold	Set the TOD algorithm threshold for, missing TOD per bus on, each bus to N for initializing the designated bus	8
6	Select Bus A or Bus B for Data Output	This bit is used to select which bus A or B data is output on.. Causes all the network addresses in the current IP address table to change to the selected value. Bus A (network address=15) = “1” Bus B (network address=16) = “0”	1
7	Initialize and configure Bus A	Initialize the interface on Bus A to prepare for data transmission	1
8	Initialize and configure Bus B	Initialize the interface on Bus B to prepare for data transmission "1" = Initialize	1
9	Reset TOD_Loss_BusA_Cntr	Reset the TOD packet loss event counter for bus A Reset = 1	1
10	Reset TOD_Loss_BusB_Cntr	Reset the TOD packet loss event counter for bus B Reset = 1	1
11	Reset TOD_Loss_BusAB_Cntr	Reset the TOD packet loss counter for bus A loss coincident with bus B loss Reset = 1	1
12	Enable/Disable TOD_Loss_BusA_Cntr	Enables or disables further counting of missing TOD on TOD_Loss_BusA_Cntr "1" = Enable ”0” = Disable	1
13	Enable/Disable TOD_Loss_BusB_Cntr	Enables or disables further counting of missing TOD on TOD_Loss_BusB_Cntr "1" = Enable ”0” = Disable	1
14	Enable/Disable TOD_Loss_BusAB_Cntr	Enables or disables further counting of missing TOD on TOD_Loss_BusAB_Cntr "1" = Enable ”0” = Disable	1

3.2.12.2 Host Application Layer Table Load

IRD1394S210000 The host shall accept a table load containing the following bit definitions on the command data field and load the data replacing the default values for IP addresses and Port numbers. [Host] {T}

Table 3.2.12-2 Host IP Address & Port Number Table Load Format

Data Field	Bit Qty	Bit Position
TMON IP Address	32	0 -31
TMON Port Number	16	32 -47

HK IP Address	32	48 -79
HK Port Number	16	80 -95
Engineering Data IP Address	32	96 -127
Engineering Data Port Number	16	128 -143
Science Data IP Address	32	144 -175
Science Data Port Number	16	176 -191
Calibration Data IP Address	32	192 -223
Calibration Data Port Number	16	224 -239
Diagnostics Data IP Address	32	240 -271
Diagnostics Data Port Number	16	272 -287
Dwell Data IP Address	32	288 -319
Dwell Data Port Number	16	320 -335
Data for LRD Processing IP Address	32	336 -367
Data for LRD Processing Port Number	16	368 -383
Subnet & Bit Service Data IP Address	32	384 -415
Subnet & Bit Service Data Port Number	16	416 -431

3.2.12.3 Network Manager Application Layer Commands

TBD

3.2.12.4 Driver Commands

IRD1394S220005 The Host usage of the driver shall output responses to IP Pings within 200 milliseconds of receipt by the PHY. [Host] {T}

IRD1394S220010 Usage of IP Ping by the Network Manager shall allow for a minimum of 250 TBR milliseconds for response prior to a retry. [NM] {A}

3.2.12.5 Deleted

3.2.13 Telemetry

3.2.13.1 Host Application Layer Telemetry

IRD1394S220200 The Host shall request driver statistics and telemeter the 8 LSB of the 32 bit words of IRD1394S220410 items 1, 2, 3, 4, 5, 6, 7 and 9. [Host] {T}

IRD1394S220210 The Host shall embed a 4-byte count of application layer Telecommands received within its normal telemetry stream. [Host] {T} *Inclusion of this data in telemetry allows the ground to know that the host has received all commands.*

3.2.13.2 Network Manager Application Layer Telemetry

IRD1394S220300 The Network Manager shall contain a log of actions taken due to the events detected. [NM] {T}

IRD1394S220310 The NM shall request driver statistics, in addition to those of the host on which it resides, and telemeter the 8 LSB of the item 10 32 bit word of IRD1394S220410. [NM] {T}

IRD1394S220320 The NM shall count IP Ping response errors for each host and telemeter the 8 LSB value for each. [NM] {T}

IRD1394S220330 The NM shall be capable of measuring the round trip time between initiating an IP Ping and receipt of the Ping response placing the value in milliseconds up to 32 bits in telemetry for each host within the network. [NM] {T} *This is to be used to track performance degradation over time if any and may not be required after sufficient testing and analysis has been performed*

3.2.13.3 Driver Status Telemetry

IRD1394S220400 The 1394 Driver shall produce statistics to be accessed by an API call. [Driver] {T}

IRD1394S220410 The 1394 Driver statistics shall include: Number of erroneous IP packets received, (1) Number of errors in transmitting IP packets, (2) Low Level Interface Error, (3) Output Dynamic Buffer High Water mark Indicator, (4) Input Dynamic Buffer High Water mark Indicator, (5) FIFO Under-run, (6) LLC descriptor block read unrecoverable error, (7) LLC host memory write error, (8) Deleted, (9) Destination node did not accept the block packet due to an error, (10) Round trip time in milliseconds of the last PING request/reply, (11) PING send request error code if any, (12) PING receive error code if any. [Driver] {T}

3.2.14 Logging

The 1394 Log Management function is responsible for maintaining the 1394 fault logs and fault response activity logs. These logs provide key information for later ground analysis in the event that 1394 Network communication is disrupted. The fault and activity logs may be a single log or may be broken into two logs depending on host needs. The Fault Logs provide visibility to the ground into how the 1394 Network is functioning. If a Host already has a Fault Log and/or Activity Log, 1394 Faults and Activities may be stored in these existing logs.

IRD1394S220500 .A Fault log shall be maintained by the Host to provide a history of Host detected 1394 faults that have occurred and actions taken related to those faults. [Host] {A}

IRD1394S220510 The Host Fault Log shall be capable of holding a minimum of 16 entries. [Host] {I}

IRD1394S220520 Host actions taken due to fault events shall be logged. [Host] {T}

IRD1394S220530 1394 Host actions taken due to 1394 fault events shall not be overwritten until commanded. [Host] {T}

IRD1394S220540 Each Fault Log shall contain a Full Flag indicating the Fault Log has filled up . [Host] {T} *The Full Flag remains set until the ground clears the Fault Log*.

IRD1394S220550 Each entry in the Fault Log shall contain a time tag, a fault identifier, and fault specific information. [Host] {I} *The fault specific data words provide additional, detailed information about a given fault. This information helps the ground identify why a given fault occurred.*

IRD1394S220570 Faults and related operations for the purpose of logging, shall include fault event that results in action by the host, initiation of bus reset by the host, and Host transition to safe mode. [Host] {T} *1394 Fault Log is maintained by the Host flight software to provide a history of significant 1394 fault related activities that have been initiated by the Host flight software. . Activities occurring on a given Host are logged in that Host's FaultLog.*

IRD1394S220580 The host normal HK telemetry packet shall contain an indication of data present in the Fault Log. [Host] {T}

IRD1394S220590 The Host Fault Log shall be capable of being output upon request. [Host] {T}

IRD1394S220600 The method for requesting the fault log information shall be documented in the host ICD [Host] {T}

3.3 Performance

IRD1394S007000 The FT1394 Serial Bus shall provide S100 performance per the IEEE 1394a specification when all nodes and cables are connected as specified in this document. [SC]

IRD1394S007002 Driver shall fit within 250 KB exclusive of buffers and stack working space. [Driver]

IRD1394S007004 The driver shall consume no more than 0.5 (TBR) MIPS per megabytes-per-second of data transported into and out of the NI onto the FT1394 data bus. [Driver]

3.3.1 Quality of Service

3.3.1.1 Data Rate

The following requirements in this section are specified including system margin, 50%, and are therefore to be used as acceptance test cases. This set of test cases proves both flight capability to perform communication without data loss and the margin requirements on contract.

IRD1394S007010 Each host shall support their traffic conditions in Table 3.3.1-1 including specified margin. [SC, Host]

Case #	Specified relative to user		VIIRS	CMIS	CrIS	DSU	SCP (Root)	PSP	Spare	Test
1	Bus A	Input	0.064	0.064	0.064	52.740	0.009	0.064	0.064	0.000
		Output	41.252	0.812	3.752	0.002	3.237	6.482	0.002	0.000
	Bus B	Input	0.064	0.064	0.064	0.064	0.009	0.064	0.064	0.000
		Output	0.002	0.002	0.002	0.002	0.386	0.002	0.002	0.000
2	Bus A	Input	0.064	0.064	0.064	11.490	0.009	0.064	0.064	0.000
		Output	0.002	0.812	3.752	0.002	3.237	6.482	0.002	0.000
	Bus B	Input	0.064	0.064	0.064	41.314	0.009	0.064	0.064	0.000
		Output	41.252	0.002	0.002	0.002	0.386	0.002	0.002	0.000

Table 3.3.1-1 Network CCSDS Traffic Conditions (Mbps) including 50% margin

3.3.1.2 Bandwidth Allocation

In asynchronous mode, no bandwidth is guaranteed.

IRD1394S007030 The spacecraft shall accept asynchronous data from each host at a peak per second rate equal to or greater than the peak sensor contract rate where the last available CCSDS packet within a host may take up to 1 second from time it is available to time it is accepted on the FT1394 network as required by 3.2.6.2.3.1. [SC]

3.3.1.3 Latency

Asynchronous mode does not guarantee latency.

IRD1394S007040 Data from any source shall be accepted within one sensor science cycle period plus 1 second or 3 seconds if the source has no specific cyclical period. [SC] *A cycle is the repeating period from start of to stop data collection or generation of the main repetitive source of data.*

IRD1394S007050 The host shall make available all output data produced within a science cycle period within 1 second of completion of that cycle or where there is no specific science cycle within 1 second of data production. [Host]

3.3.1.4 Bit Error Rate (BER)

IRD1394S007060 Each 1394 network shall communicate data from the source NI to the destination NI with less than 1 bit error in 10^{10} bits transmitted. [SC]

IRD1394S007070 The BER of a Host, defined to be communication errors within the host that result in erroneous data being passed to the NI or data loss, shall be less than 1 bit error in 10^{10} bits transmitted. [Host]

IRD1394S007080 The Network BER shall be inclusive of any error correction performed within the defined communication path. [SC]

IRD1394S007090 BER shall include bit error propagation affects, defined to be one or more bit errors causing the loss of many bits of data. [SC, Host]

3.3.1.5 Noise

3.3.2 Availability

3.3.2.1 Data Availability

Data availability loss for FT1394 is defined to be only due to bit errors and not due to any failures of hardware except single event upsets.

3.3.3 Time-of-Day

3.3.3.1 Time Code Arrival Timing

IRD1394S007110 The broadcast Time-of-Day data shall arrive at the Host between 100ms and 900ms prior to the arrival of the next Time-of-Day pulse per Figure 3.3.3-1. [SC]

IRD1394S007120 The time code packet shall be broadcast to all users using 1394 asynchronous mode transfers. [SC]

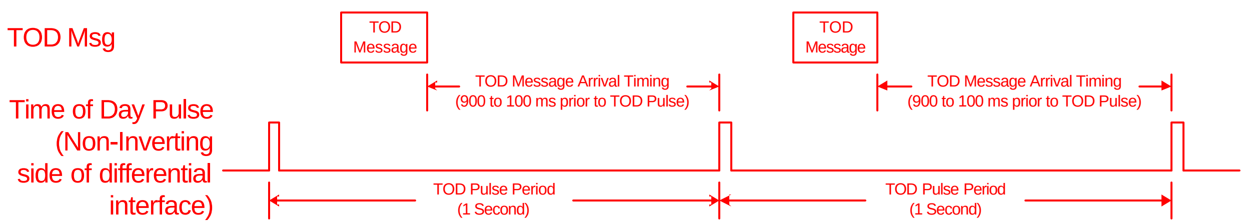

Figure 3.3.3-1 One Second Time-of-Day Timing

3.3.3.2 Time-of-Day Uncertainty With Time-of-Day Pulse

IRD1394S007130 The Time-of-Day pulse sent in the TOD packet shall correspond to international standard UTC time at the occurrence of the TOD pulse $\pm$ 200 microseconds. [SC]

IRD1394S007140 The Host additional time-of-day uncertainty as included in the packet shall be less than 500 microseconds. [Host]

3.4 System Operations

3.4.1 Normal Host 1394 Initialization

IRD1394S014000 The host upon receiving an error condition as a direct result of a call to initialize or reinitialize the driver shall log the fault and wait for communication on the alternate bus. [Host] {T}

IRD1394S014010 The host upon receiving errors resulting from calls to initialize the driver for both bus A and bus B shall transition to safe mode. [Host] {T} *The causes of this condition are operator error and a host major software/hardware faults. Recovery requires the host power to be cycled. It is therefore not possible to fetch the fault log.*

IRD1394S014020 Host 1394 Initialization shall consist of Driver Initialization and Host Bus Configuration, or, driver re-initialization and Host Bus Re-Configuration where the sequence of calls and how to use them are part of the driver user's manual. [Host] {I}.

IRD1394S014030 The Driver user's manual shall include descriptions of Host 1394 Initialization and Re-Initialization. [Driver] {I}.

3.4.1.1 Power Application

3.4.1.1.1 First Cable Power Application

IRD1394S014050 The system shall power on the Root Node and Network Manager before all other nodes. [Sys]

IRD1394S014100 The Network Manager shall apply power to Bus A and Bus B with minimal delay between the two operations prior to application of power to other hosts. [NM]

IRD1394S014200 Each node on the network shall initialize to repeater mode with cable power applied but host power off. [NI]

IRD1394S014500 Power shall be applied to Physical Layer interfaces prior to the application of power to the Host. [SC, Gnd] **~~To correct for a chip errata. There is no longer the ability to enable or disable in the hosts. This change was not made.~~**

3.4.1.1.2 **Subsequent Power Application**

IRD1394S015000 Application of power to Bus A and Bus B shall be within 512 milliseconds . [SC, Gnd]

3.4.2 Deleted

3.4.3 Deleted

3.4.4 Deleted

4 VERIFICATION

4.1 Verification Methods

IRD1394S100000 Methods of verification shall be selected from the following:

4.1.1 Not Applicable

IRD1394S100010 Use of the term "Not Applicable" shall be limited to those paragraph/paragraph headings for which there is no method of verification or where verification is accomplished in subparagraphs.

4.1.2 Inspection

IRD1394S100100 Inspection is the verification method used to verify characteristics of an item by inspecting engineering documentation produced during development or by inspection of the product itself to verify conformance with specified requirements. Inspection is nondestructive and consists of visual inspections or simple measurements without the use of precision measurement equipment. For acceptance of an item, verification by inspection includes the assessment of similarity of the characteristics of subsequent items to the corresponding characteristics of the first item generated based on a common design.

4.1.3 Analysis

IRD1394S100200 Analysis is the verification method used to verify requirements by determining qualitative and quantitative properties and performance of the system by studying and examining engineering drawings, software, and hardware flow diagrams, software and hardware specifications, and other software and hardware documentation (e.g., Commercial Off-the-Shelf (COTS) vendor documentation). It also includes performing modeling, simulation, and/or calculations and analyzing the results. Analysis techniques include interpretation or interpolation/extrapolation of analytical or empirical data collected under defined conditions or reasoning to show theoretical compliance with requirements.

4.1.4 Test

IRD1394S100300 Test is an action that verifies an item's operability, supportability, performance capability, or other specified qualities when subjected to controlled conditions that are real or simulated. These verifications may require use of special test equipment and instruments to obtain quantitative data for analysis as well as qualitative data derived from displays and indicators inherent in the item(s) for monitor and control.

4.2 Verification Cross Reference

Starting with paragraph 3, each requirement of this specification shall be verified by the method (or, combination of methods) specified in the Verification Matrix (Table 4.1.4-1). In the case of paragraph headings, or non-requirement text, "Not Applicable (NA)" is noted in the verification matrix.

Verification Nomenclature: N = Not Applicable; I = Inspection; A = Analysis; T = Test

Table 4.1.4-1. Verification Cross Reference Matrix (VCRM)

				Verification Method			
Paragraph	**Title**		**Requirement ID**	**N**	**I**	**A**	**T**
3	REQUIREMENTS			X			
3.1	System Concept			X			
3.1.1	System Configuration			X			
3.1.1.1	Bus Communication Functions		IRD1394S000100				X
3.1.1.1	Bus Communication Functions		IRD1394S000110				X
3.1.1.1	Bus Communication Functions		IRD1394S000120				X
3.1.1.1	Bus Communication Functions		IRD1394S000130				X
3.1.1.1	Bus Communication Functions		IRD1394S000140				X
3.1.1.1	Bus Communication Functions		IRD1394S000150				X
3.1.1.1	Bus Communication Functions		IRD1394S000160				X
3.1.1.1	Bus Communication Functions		IRD1394S000170				X
3.1.1.1	Bus Communication Functions		IRD1394S000180				X
3.1.1.1	Bus Communication Functions		IRD1394S000190				X
3.1.1.1	Bus Communication Functions		IRD1394S000200				X
3.1.1.1	Bus Communication Functions		IRD1394S000210				X
3.1.1.2	Data Rates		IRD1394S000250				X
3.1.2	Interface Configuration		IRD1394S000300		X	X	
3.1.3.1	Physical Topology		IRD1394S000400		X		
3.1.3.2	Logical Topology		IRD1394S000450			X	
3.1.3.2	Logical Topology		IRD1394S000460				X
3.1.3.3	Nodes		IRD1394S000500		X		
3.1.3.3	Nodes		IRD1394S000510		X		
3.1.3.3	Nodes		IRD1394S000520				X
3.1.3.3	Nodes		IRD1394S000530				X
3.1.3.3.1	Network Manager		IRD1394S000600			X	
3.1.3.3.1	Network Manager		IRD1394S000610				X
3.1.3.3.1	Network Manager		IRD1394S000620				X
3.1.3.3.2	Root Node		IRD1394S000700				X

				Verification Method			
Paragraph	**Title**		**Requirement ID**	**N**	**I**	**A**	**T**
3.1.3.3.2	Root Node		IRD1394S000710				X
3.1.3.3.2	Root Node		IRD1394S000720				X
3.1.3.3.2	Root Node		IRD1394S000730			X	
3.1.3.3.2	Root Node		IRD1394S000740				X
3.1.3.3.2	Root Node		IRD1394S000750				X
3.1.3.3.2	Root Node		IRD1394S000760				X
3.1.3.3.2	Root Node		IRD1394S000770				X
3.1.3.3.3	Host Nodes		IRD1394S000900				X
3.1.3.3.3	Host Nodes		IRD1394S000910		X	X	
3.1.3.3.3	Host Nodes		IRD1394S000920		X	X	
3.1.3.3.3	Host Nodes		IRD1394S000930		X	X	
3.1.3.3.3	Host Nodes		IRD1394S000940		X		
3.1.3.3.3	Host Nodes		IRD1394S000950		X		
3.1.3.3.3	Host Nodes		IRD1394S000960		X		
3.1.3.3.3	Host Nodes		IRD1394S000970		X		
3.1.3.3.4	Fault Tolerance		IRD1394S200000		X		
3.1.3.3.4	Fault Tolerance		IRD1394S200010		X		
3.1.3.3.5	Bus Repeater		IRD1394S001100				X
3.1.3.3.5	Bus Repeater		IRD1394S001110			X	
3.1.3.3.6	Maximum Physical System		IRD1394S001220			X	
3.1.3.3.6	Maximum Physical System		IRD1394S001230			X	
3.1.3.3.7	Fault Zones		IRD1394S200100				X
3.1.3.3.7	Fault Zones		IRD1394S200110				X
3.1.3.3.7	Fault Zones		IRD1394S200120				X
3.1.3.3.7	Fault Zones		IRD1394S200130			X	
3.1.3.3.8	Node Redundancy		IRD1394S001300		X		
3.1.3.3.9	Expandability		IRD1394S001400			X	
3.1.3.3.9	Expandability		IRD1394S001410			X	
3.1.3.3.9	Expandability		IRD1394S001420		X		
3.1.3.3.9	Expandability		IRD1394S001430		X		
3.1.3.4	Interconnection		IRD1394S001500		X		

				Verification Method			
Paragraph	Title		Requirement ID	N	I	A	T
3.1.3.4.1	Bus-to-Bus Isolation		IRD1394S001550		X		
3.1.3.4.1	Bus-to-Bus Isolation		IRD1394S001560			X	
3.1.3.5	Network Power		IRD1394S001600		X		
3.1.3.5	Network Power		IRD1394S001610			X	
3.1.3.6	Node Operational Redundancy		IRD1394S001700				X
3.1.3.6	Node Operational Redundancy		IRD1394S001710				X
3.1.3.6	Node Operational Redundancy		IRD1394S001720		X		
3.1.3.6	Node Operational Redundancy		IRD1394S001730				X
3.1.3.6	Node Operational Redundancy		IRD1394S001740		X		
3.1.3.6	Node Operational Redundancy		IRD1394S001750		X		
3.1.3.6	Node Operational Redundancy		IRD1394S001760			X	
3.1.3.6	Node Operational Redundancy		IRD1394S001770				X
3.1.3.6	Node Operational Redundancy		IRD1394S001780				X
3.1.3.6	Node Operational Redundancy		IRD1394S001790				X
3.1.3.6	Node Operational Redundancy		IRD1394S001800				X
3.1.3.6	Node Operational Redundancy		IRD1394S001810				X
3.1.3.6	Node Operational Redundancy		IRD1394S001820				X
3.1.3.6	Node Operational Redundancy		IRD1394S001830		X		
3.1.3.6	Node Operational Redundancy		IRD1394S001840			X	
3.1.3.7	Gap Time		IRD1394S001900				X
3.1.3.7	Gap Time		IRD1394S001910		X		
3.1.3.7	Gap Time		IRD1394S001920				X
3.2	Functions			X			
3.2.1	Network Management			X			
3.2.1.1	Network Power Management		IRD1394S002000				X
3.2.1.2	Network Initialization			X			
3.2.1.2.1	Initialization Time		IRD1394S002100				X
3.2.1.2.1	Initialization Time		IRD1394S002110			X	
3.2.1.2.1.1	Time for Tree Identify		IRD1394S002150				X
3.2.1.2.1.2	Time for Self Identify		IRD1394S002160				X
3.2.1.2.2	Bus Initialization and Arbitration			X			

				Verification Method			
Paragraph	**Title**		**Requirement ID**	**N**	**I**	**A**	**T**
3.2.1.2.2.1	Bus-Reset		IRD1394S002200				X
3.2.1.2.2.1	Bus-Reset		IRD1394S002210				X
3.2.1.2.2.1	Bus-Reset		IRD1394S002220				X
3.2.1.2.2.1	Bus-Reset		IRD1394S002230				X
3.2.1.2.2.1	Bus-Reset		IRD1394S002240				X
3.2.1.2.2.1	Bus-Reset		IRD1394S002250				X
3.2.1.2.2.1	Bus-Reset		IRD1394S002260				X
3.2.1.2.2.1	Bus-Reset		IRD1394S002270				X
3.2.1.2.2.1	Bus-Reset		IRD1394S002280				X
3.2.1.2.2.1	Bus-Reset		IRD1394S002290				X
3.2.1.2.2.1	Bus-Reset		IRD1394S002300				X
3.2.1.2.2.1	Bus-Reset		IRD1394S002310				X
3.2.1.2.2.2	Tree Identify		IRD1394S002400				X
3.2.1.2.2.2	Tree Identify		IRD1394S002410				X
3.2.1.2.2.3	Self-Identify			X			
3.2.1.3	Serial Bus Management			X			
3.2.1.3.1	Cycle Master		IRD1394S002500			X	
3.2.1.3.2	Network Manager		IRD1394S002510			X	
3.2.1.3.2	Network Manager		IRD1394S002520			X	
3.2.1.3.3	Isochronous Resource Manager		IRD1394S002550			X	
3.2.1.4	Address Resolution Protocol (ARP)		IRD1394S002600		X		
3.2.1.4	Address Resolution Protocol (ARP)		IRD1394S002610		X		
3.2.1.5	Bus Arbitration		IRD1394S002700				X
3.2.1.5	Bus Arbitration		IRD1394S002710			X	
3.2.1.5	Bus Arbitration		IRD1394S002720			X	
3.2.2	Data Transfers		IRD1394S002800			X	
3.2.2	Data Transfers		IRD1394S002810			X	
3.2.2.1	Transaction Scheme		IRD1394S002850			X	
3.2.2.1	Transaction Scheme		IRD1394S002860		X		
3.2.2.1	Transaction Scheme		IRD1394S002870			X	
3.2.2.1	Transaction Scheme		IRD1394S002880			X	

			Verification Method			
Paragraph	**Title**	**Requirement ID**	**N**	**I**	**A**	**T**
3.2.2.1	Transaction Scheme	IRD1394S002890			X	
3.2.2.1	Transaction Scheme	IRD1394S002900			X	
3.2.2.1	Transaction Scheme	IRD1394S002910				X
3.2.2.1	Transaction Scheme	IRD1394S002920				X
3.2.2.1	Transaction Scheme	IRD1394S002930				X
3.2.2.1	Transaction Scheme	IRD1394S002940			X	
3.2.2.1	Transaction Scheme	IRD1394S002950				X
3.2.2.1	Transaction Scheme	IRD1394S002960				X
3.2.2.1	Transaction Scheme	IRD1394S002970				X
3.2.2.1	Transaction Scheme	IRD1394S002980			X	
3.2.2.1.1	FT1394 Packet Size	IRD1394S003000		X		
3.2.2.2	1394 Broadcast	IRD1394S003020		X		
3.2.2.2	1394 Broadcast	IRD1394S003030			X	
3.2.2.2	1394 Broadcast	IRD1394S003040				X
3.2.2.2	1394 Broadcast	IRD1394S003050				X
3.2.2.2	1394 Broadcast	IRD1394S200270				X
3.2.2.3	1394 Multicast		X			
3.2.3	Physical and Link Layers		X			
3.2.3.1	Common Implementation	IRD1394S003100		X		
3.2.3.2	Physical and Link Layers	IRD1394S003110				X
3.2.3.2	Physical and Link Layers	IRD1394S003120				X
3.2.3.3	Multicast Over FT1394IP Multicast		X			
3.2.3.4.1	Finished Cables	IRD1394S003200			X	
3.2.3.4.1	Finished Cables	IRD1394S003210				X
3.2.3.4.1	Finished Cables	IRD1394S003220				X
3.2.3.4.1	Finished Cables	IRD1394S003230		X		
3.2.3.4.1	Finished Cables	IRD1394S003240				X
3.2.3.4.1	Finished Cables	IRD1394S003250				X
3.2.3.4.1	Finished Cables	IRD1394S003260				X
3.2.3.4.1	Finished Cables	IRD1394S003270				X
3.2.3.4.1	Finished Cables	IRD1394S003280				X

				Verification Method			
Paragraph	Title		Requirement ID	N	I	A	T
3.2.3.4.2	Connector Designators		IRD1394S003300		X		
3.2.3.4.2	Connector Designators		IRD1394S003310		X		
3.2.3.4.3	Connectors		IRD1394S003320		X		
3.2.3.4.3	Connectors		IRD1394S003330		X		
3.2.3.4.3	Connectors		IRD1394S003340		X		
3.2.3.4.3	Connectors		IRD1394S003350		X		
3.2.3.4.3	Connectors		IRD1394S003360		X		
3.2.3.4.3	Connectors		IRD1394S003370		X		
3.2.3.4.3.1	Connector Pin-outs		IRD1394S003400		X		
3.2.3.4.3.2	Connector Mating		IRD1394S003410		X		
3.2.3.4.3.2	Connector Mating		IRD1394S003420		X		
3.2.3.4.3.2	Connector Mating		IRD1394S003430		X		
3.2.3.4.3.2	Connector Mating		IRD1394S003440		X		
3.2.3.4.4	Connector Identification		IRD1394S003460		X		
3.2.3.4.5	Bulkhead Feed Through Connectors		IRD1394S003470		X		
3.2.3.4.5	Bulkhead Feed Through Connectors		IRD1394S003480		X		
3.2.3.4.5	Bulkhead Feed Through Connectors		IRD1394S003490		X		
3.2.3.5	1394 Electrical Interface		IRD1394S003500		X	X	
3.2.3.5.1	Network Cable to Host Isolation		IRD1394S003510			X	
3.2.3.5.1	Network Cable to Host Isolation		IRD1394S003530			X	
3.2.3.5.1	Network Cable to Host Isolation		IRD1394S003540			X	
3.2.3.6	Power			X			
3.2.3.6.1	Cable Power		IRD1394S003600		X		
3.2.3.6.1	Cable Power		IRD1394S003610			X	
3.2.3.6.1	Cable Power		IRD1394S003620				X
3.2.3.6.1	Cable Power		IRD1394S003630				X
3.2.3.6.1	Cable Power		IRD1394S003640			X	
3.2.3.6.1	Cable Power		IRD1394S003660				X
3.2.3.6.2	Cable Power Distribution		IRD1394S003700				X
3.2.3.6.2	Cable Power Distribution		IRD1394S003710			X	
3.2.3.6.2	Cable Power Distribution		IRD1394S003720				X

				Verification Method			
Paragraph	Title		Requirement ID	N	I	A	T
3.2.3.6.2	Cable Power Distribution		IRD1394S003725			X	
3.2.3.6.2	Cable Power Distribution		IRD1394S003730			X	
3.2.3.6.2	Cable Power Distribution		IRD1394S003740				X
3.2.3.6.3	Cable Power Source		IRD1394S003800				X
3.2.3.6.3	Cable Power Source		IRD1394S003810			X	
3.2.3.6.3	Cable Power Source		IRD1394S003820			X	
3.2.3.6.3	Cable Power Source		IRD1394S003830			X	
3.2.3.6.3	Cable Power Source		IRD1394S003840		X		
3.2.3.6.3	Cable Power Source		IRD1394S003850				X
3.2.3.6.3	Cable Power Source		IRD1394S003860			X	
3.2.3.6.4	Power and ground Isolation		IRD1394S003900			X	
3.2.3.6.4	Power and ground Isolation		IRD1394S003910			X	
3.2.3.6.4	Power and ground Isolation		IRD1394S003920			X	
3.2.3.6.4	Power and ground Isolation		IRD1394S003930			X	
3.2.3.6.5	Power Sequencing		IRD1394S004000				X
3.2.3.6.5	Power Sequencing		IRD1394S004010				X
3.2.3.6.5	Power Sequencing		IRD1394S004040			X	
3.2.3.6.5	Power Sequencing		IRD1394S004050			X	
3.2.3.6.5	Power Sequencing		IRD1394S004060				X
3.2.3.7	Grounding		IRD1394S004100				X
3.2.3.7	Grounding		IRD1394S004120				X
3.2.3.7	Grounding		IRD1394S004130		X		
3.2.3.7	Grounding		IRD1394S004140			X	
3.2.3.7	Grounding		IRD1394S004150			X	
3.2.3.7	Grounding		IRD1394S004160				X
3.2.3.7	Grounding		IRD1394S004170				X
3.2.3.7	Grounding		IRD1394S004180				X
3.2.3.7	Grounding		IRD1394S004190				X
3.2.3.7.1	Single Point Ground		IRD1394S004200				X
3.2.3.8	Fault Tolerance			X			
3.2.3.8.1	Faults		IRD1394S200200			X	

				Verification Method			
Paragraph	**Title**		**Requirement ID**	**N**	**I**	**A**	**T**
3.2.3.8.1	Faults		IRD1394S200220			X	
3.2.3.8.1	Faults		IRD1394S200230			X	
3.2.3.8.1	Faults		IRD1394S200240			X	
3.2.3.8.1	Faults		IRD1394S200250			X	
3.2.3.8.2	Redundancy		IRD1394S200300		X		
3.2.3.8.2	Redundancy		IRD1394S200310		X		
3.2.3.8.2	Redundancy		IRD1394S200320		X		
3.2.3.8.2	Redundancy		IRD1394S200330		X		
3.2.3.8.2	Redundancy		IRD1394S200340				X
3.2.4	Network Layer		IRD1394S004300		X		
3.2.4.1	Common Implementation		IRD1394S004310		X		
3.2.4.2	Network Class			X			
3.2.4.3	IP Addresses		IRD1394S004330		X		
3.2.4.3	IP Addresses		IRD1394S004340		X		
3.2.4.3	IP Addresses		IRD1394S004350		X		
3.2.4.3	IP Addresses		IRD1394S004360				X
3.2.4.3	IP Addresses		IRD1394S004365		X		
3.2.4.3	IP Addresses		IRD1394S004366		X		
3.2.4.3	IP Addresses		IRD1394S004367		X		
3.2.4.4	Error Handling			X			
3.2.4.4.1	Physical Layer Packet Loss Affect		IRD1394S004380				X
3.2.5	Transport Layer		IRD1394S004400		X		
3.2.5.1	Common Implementation		IRD1394S004410		X		
3.2.5.2	Auxiliary Networking Functions			X			
3.2.5.2.1	Output Threads		IRD1394S004440			X	
3.2.5.3	Error Handling			X			
3.2.5.3.1	IP Packet Loss Affect on UDP Layer		IRD1394S004470				X
3.2.6	Application Layer			X			
3.2.6.1	Host Data Protocol (CCSDS)		IRD1394S004500		X		
3.2.6.1	Host Data Protocol (CCSDS)		IRD1394S004510		X		
3.2.6.1.1	CCSDS Packet Boundaries		IRD1394S004520		X		

				Verification Method			
Paragraph	**Title**		**Requirement ID**	**N**	**I**	**A**	**T**
3.2.6.1.1.1	Byte/Octet Padding		IRD1394S004530			X	
3.2.6.1.2	Data Packet Size		IRD1394S004540		X		
3.2.6.1.3	Content and Structure		IRD1394S004600		X		
3.2.6.1.3	Content and Structure		IRD1394S004610		X		
3.2.6.1.3	Content and Structure		IRD1394S004620		X		
3.2.6.1.3	Content and Structure		IRD1394S004630		X		
3.2.6.1.3	Content and Structure		IRD1394S004640		X		
3.2.6.1.3	Content and Structure		IRD1394S004650		X		
3.2.6.1.3	Content and Structure		IRD1394S004660		X		
3.2.6.1.3	Content and Structure		IRD1394S004670		X		
3.2.6.1.3	Content and Structure		IRD1394S004680		x		
3.2.6.1.3.1	Primary Header			X			
3.2.6.1.3.2	APID		IRD1394S004700		X		
3.2.6.1.3.3	Sequence Flag:		IRD1394S004710		X		
3.2.6.1.3.4	Packet Sequence Count:		IRD1394S004720				X
3.2.6.1.3.4	Packet Sequence Count:		IRD1394S004730			X	X
3.2.6.1.3.5	CCSDS Packet Header Location		IRD1394S004740			X	
3.2.6.1.3.6	Secondary Header		IRD1394S004750		X		
3.2.6.1.3.7	Time-of-Day		IRD1394S004760				X
3.2.6.1.3.7	Time-of-Day		IRD1394S004770			X	
3.2.6.1.3.7	Time-of-Day		IRD1394S004780		X		
3.2.6.1.3.8	Number of Packet Segments		IRD1394S004790		X		
3.2.6.1.4	CRC and Checksums			X			
3.2.6.1.4.1	Telecommand CRC Usage		IRD1394S004800				
3.2.6.1.4.2	Telemetry CRC Usage		IRD1394S004810		X		
3.2.6.1.5	Application Identifiers (APIDs)			X			
3.2.6.1.5.1	APIDs and Packet Types		IRD1394S004830		X		
3.2.6.1.5.1	APIDs and Packet Types		IRD1394S004840		X		
3.2.6.1.5.1.1	APIDs and Source Packet Selection		IRD1394S004850		X		
3.2.6.1.5.1.1	APIDs and Source Packet Selection		IRD1394S004860				X
3.2.6.1.5.1.2	APIDs and Compressed Data		IRD1394S004870		X		

			Verification Method			
Paragraph	**Title**	**Requirement ID**	**N**	**I**	**A**	**T**
3.2.6.1.5.2	APID Packet Documentation	IRD1394S004880		X		
3.2.6.1.5.2	APID Packet Documentation	IRD1394S004890		X		
3.2.6.1.5.2	APID Packet Documentation	IRD1394S004900			X	
3.2.6.1.5.3	APID Assignment	IRD1394S004910			X	
3.2.6.1.5.3	APID Assignment	IRD1394S004920		X		
3.2.6.1.5.4	APID Reuse	IRD1394S004930		X		
3.2.6.1.5.5	Telecommand APIDs	IRD1394S004940		X		
3.2.6.1.5.6	Command APIDs	IRD1394S004950		X		
3.2.6.1.5.6	Command APIDs	IRD1394S004960		X		
3.2.6.1.5.6	Command APIDs	IRD1394S004970		X		
3.2.6.1.5.7	Memory Load APIDs	IRD1394S004980		X		
3.2.6.1.5.7	Memory Load APIDs	IRD1394S004990		X		
3.2.6.1.5.7	Memory Load APIDs	IRD1394S005000		X		
3.2.6.2	Telemetry		X			
3.2.6.2.1	Telemetry Maximum Bandwidth	IRD1394S005100			X	X
3.2.6.2.2	Host Data Types	IRD1394S005110		X		
3.2.6.2.2.1	Housekeeping Data	IRD1394S005120		X		
3.2.6.2.2.1	Housekeeping Data	IRD1394S005130		X		
3.2.6.2.2.1.1	Housekeeping Data Rate	IRD1394S005140		X		
3.2.6.2.2.1.1	Housekeeping Data Rate	IRD1394S005150		X		
3.2.6.2.2.1.1	Housekeeping Data Rate	IRD1394S005160			X	X
3.2.6.2.2.1.1	Housekeeping Data Rate	IRD1394S005170			X	X
3.2.6.2.2.1.1	Housekeeping Data Rate	IRD1394S005180				X
3.2.6.2.2.1.2	Housekeeping Data Timeliness	IRD1394S005190		X		
3.2.6.2.2.2	LEO&A	IRD1394S005200		X		
3.2.6.2.2.2	LEO&A	IRD1394S005210		X		X
3.2.6.2.2.2.1	LEO&A Housekeeping Data Rate	IRD1394S005220		X		
3.2.6.2.2.2.1	LEO&A Housekeeping Data Rate	IRD1394S005230				X
3.2.6.2.2.3	Calibration Data	IRD1394S005250		X		
3.2.6.2.2.4	Dwell Data	IRD1394S005260		X		
3.2.6.2.2.5	Science Data	IRD1394S005270		X		

				Verification Method			
Paragraph	**Title**		**Requirement ID**	**N**	**I**	**A**	**T**
3.2.6.2.2.5	Science Data		IRD1394S005410		X		
3.2.6.2.2.5.1	Science Data Rate		IRD1394S005280		X		
3.2.6.2.2.6	Diagnostic Data		IRD1394S005300		X		
3.2.6.2.2.6.1	Diagnostic Data Rate		IRD1394S005310		X		
3.2.6.2.2.6.2	Diagnostic Data Transfer		IRD1394S005320		X		
3.2.6.2.2.7	Engineering Data		IRD1394S005330		X		
3.2.6.2.2.8	Telemetry Monitor Data (if necessary)		IRD1394S005340		X		
3.2.6.2.2.8	Telemetry Monitor Data (if necessary)		IRD1394S005350		X		
3.2.6.2.2.8	Telemetry Monitor Data (if necessary)		IRD1394S005360		X		
3.2.6.2.2.8	Telemetry Monitor Data (if necessary)		IRD1394S005370		X		
3.2.6.2.2.8	Telemetry Monitor Data (if necessary)		IRD1394S005380		X		
3.2.6.2.2.9	Memory Dump Data		IRD1394S005400				X
3.2.6.2.3	Host Telemetry Data Transfer Process		IRD1394S005420		X		
3.2.6.2.3.1	Host Telemetry Buffering		IRD1394S005430			X	
3.2.6.2.3.1	Host Telemetry Buffering		IRD1394S005440			X	
3.2.6.2.3.1	Host Telemetry Buffering		IRD1394S005450			X	
3.2.6.2.3.1	Host Telemetry Buffering		IRD1394S005460			X	
3.2.6.2.3.2	Host Telemetry Data Transfers		IRD1394S005470			X	
3.2.6.2.3.2	Host Telemetry Data Transfers		IRD1394S005472			X	
3.2.6.2.3.2	Host Telemetry Data Transfers		IRD1394S005476			X	
3.2.6.2.3.2	Host Telemetry Data Transfers		IRD1394S005478			X	
3.2.6.2.4	Telemetry Formatting		IRD1394S005480		X		
3.2.6.2.4	Telemetry Formatting		IRD1394S005490			X	
3.2.6.3	Commands and Memory Loads			X			
3.2.6.3.1	Command and Memory Load Packet Length		IRD1394S005500		X		
3.2.6.3.2	Documentation		IRD1394S005510		X		
3.2.6.3.3	Commands and Memory Loads Transfer			X			
3.2.6.3.3.1	Telecommand Maximum Rate		IRD1394S005520			X	
3.2.6.3.3.1	Telecommand Maximum Rate		IRD1394S005530		X		
3.2.6.3.3.1	Telecommand Maximum Rate		IRD1394S005540				X
3.2.6.3.3.1	Telecommand Maximum Rate		IRD1394S005550				X

			Verification Method			
Paragraph	**Title**	**Requirement ID**	**N**	**I**	**A**	**T**
3.2.6.3.3.2	Spacecraft Generated Telecommands and Memory Loads	IRD1394S005600				X
3.2.6.3.3.3	Telecommand Interval	IRD1394S005610				X
3.2.6.3.3.4	Ground Generated Telecommands and Memory Loads	IRD1394S005620				X
3.2.6.3.3.5	Spacecraft/Ground Memory Load Authority	IRD1394S005630				X
3.2.6.3.3.6	Spacecraft/Ground Telecommand Authority	IRD1394S005640				X
3.2.6.3.3.7	Telecommand/Memory Load Authority	IRD1394S005650				X
3.2.6.3.4	Telecommand/Memory Load Data Transfer process		X			
3.2.6.3.4.1	Large Uplink Protocol	IRD1394S005700				X
3.2.6.3.4.1	Large Uplink Protocol	IRD1394S005710				X
3.2.6.3.4.1	Large Uplink Protocol	IRD1394S005720				X
3.2.6.3.4.1	Large Uplink Protocol		X			
3.2.6.3.4.2	Partial Packets	IRD1394S005730				X
3.2.6.3.4.2	Partial Packets	IRD1394S005740				X
3.2.6.3.4.3	Partial CCSDS Packet Sets	IRD1394S005750				X
3.2.6.3.4.3	Partial CCSDS Packet Sets	IRD1394S005760				X
3.2.6.3.4.3	Partial CCSDS Packet Sets	IRD1394S005770				X
3.2.6.3.4.3	Partial CCSDS Packet Sets	IRD1394S005780				X
3.2.6.3.4.3	Partial CCSDS Packet Sets	IRD1394S005790		X		
3.2.6.3.4.3	Partial CCSDS Packet Sets	IRD1394S005800		X		
3.2.6.3.4.3	Partial CCSDS Packet Sets	IRD1394S005810			X	
3.2.6.3.4.3	Partial CCSDS Packet Sets	IRD1394S005820			X	
3.2.6.3.4.3	Partial CCSDS Packet Sets	IRD1394S005830				X
3.2.6.3.4.3	Partial CCSDS Packet Sets	IRD1394S005840				X
3.2.6.3.4.3	Partial CCSDS Packet Sets	IRD1394S005850				X
3.2.6.3.4.3	Partial CCSDS Packet Sets	IRD1394S005860				X
3.2.6.3.4.3	Partial CCSDS Packet Sets	IRD1394S005870				X
3.2.6.3.5	Command Constraint	IRD1394S005890		X		
3.2.6.3.6	Telecommand Formatting	IRD1394S005900				
3.2.6.4	Broadcast Data	IRD1394S005910				X

				Verification Method			
Paragraph	**Title**		**Requirement ID**	**N**	**I**	**A**	**T**
3.2.6.4	Broadcast Data		IRD1394S005920				X
3.2.6.4	Broadcast Data		IRD1394S005930				X
3.2.6.5	Mission Science Data to RDRs		IRD1394S005940			X	
3.2.6.5.1	Mission Data Content		IRD1394S005950			X	
3.2.6.5.2	Engineering (Auxiliary) RDR Data		IRD1394S005960		X		
3.2.6.5.3	Spacecraft Ephemeris Data		IRD1394S005970		X		
3.2.6.6	Error Handling		IRD1394S005980				X
3.2.6.7	Fault Management			X			
3.2.6.7.1	Automatic Data Retry		IRD1394S200400			X	
3.2.6.7.1	Automatic Data Retry		IRD1394S200405				X
3.2.6.7.1	Automatic Data Retry		IRD1394S200407				X
3.2.6.7.1	Automatic Data Retry		IRD1394S200410				X
3.2.6.7.1	Automatic Data Retry		IRD1394S200415				X
3.2.6.7.2	Bus Reconfiguration		IRD1394S200420				X
3.2.6.7.2	Bus Reconfiguration		IRD1394S200430		X		
3.2.6.7.2	Bus Reconfiguration		IRD1394S200440				X
3.2.6.7.2	Bus Reconfiguration		IRD1394S200450				X
3.2.6.7.2	Bus Reconfiguration		IRD1394S200460				X
3.2.6.7.2	Bus Reconfiguration		IRD1394S200470				X
3.2.6.7.2	Bus Reconfiguration		IRD1394S200472				X
3.2.6.7.2	Bus Reconfiguration		IRD1394S200474				X
3.2.6.7.2	Bus Reconfiguration		IRD1394S200476				X
3.2.6.7.2	Bus Reconfiguration		IRD1394S200480				X
3.2.6.7.2	Bus Reconfiguration		IRD1394S200481				X
3.2.6.7.2	Bus Reconfiguration		IRD1394S200482				X
3.2.6.7.2	Bus Reconfiguration		IRD1394S200490				X
3.2.6.7.3	Fault Detection Ping		IRD1394S200500				X
3.2.6.7.3	Fault Detection Ping		IRD1394S200510				X
3.2.6.7.3	Fault Detection Ping		IRD1394S200530				X
3.2.6.7.3	Fault Detection Ping		IRD1394S200531				X
3.2.6.7.3	Fault Detection Ping		IRD1394S200532				X

				Verification Method			
Paragraph	**Title**		**Requirement ID**	**N**	**I**	**A**	**T**
3.2.6.7.4	Fault Telemetry		IRD1394S200535				X
3.2.6.7.4	Fault Telemetry		IRD1394S200540				X
3.2.6.7.4	Fault Telemetry		IRD1394S200545				X
3.2.6.7.4	Fault Telemetry		IRD1394S200550				X
3.2.6.7.4	Fault Telemetry		IRD1394S200555				X
3.2.6.7.4	Fault Telemetry		IRD1394S200556			X	
3.2.6.7.4	Fault Telemetry		IRD1394S200557				X
3.2.6.7.4	Fault Telemetry		IRD1394S200558			X	
3.2.6.7.5	Host Fault Management			X			
3.2.6.7.5.1	Host 1394 initialization		IRD1394S201000				X
3.2.6.7.5.1	Host 1394 initialization		IRD1394S201005				X
3.2.6.7.5.1	Host 1394 initialization		IRD1394S201010				X
3.2.6.7.5.1	Host 1394 initialization		IRD1394S201020				X
3.2.6.7.5.1	Host 1394 initialization		IRD1394S201030				X
3.2.6.7.5.1	Host 1394 initialization		IRD1394S201035				X
3.2.6.7.5.1	Host 1394 initialization		IRD1394S201040			X	
3.2.6.7.5.1	Host 1394 initialization		IRD1394S201050			X	
3.2.6.7.5.1	Host 1394 initialization		IRD1394S201060			X	
3.2.6.7.5.1	Host 1394 initialization		IRD1394S201065		X		
3.2.6.7.5.2	Detection		IRD1394S202000		X		
3.2.6.7.5.2	Detection		IRD1394S202010		X		
3.2.6.7.5.2	Detection		IRD1394S202020		X		
3.2.6.7.5.2	Detection		IRD1394S202030		X		
3.2.6.7.5.2	Detection		IRD1394S202040				X
3.2.6.7.5.3	Response			X			
3.2.6.7.5.3.1	TOD Loss Counters		IRD1394S203000		X		
3.2.6.7.5.3.1	TOD Loss Counters		IRD1394S203010		X		
3.2.6.7.5.3.1	TOD Loss Counters		IRD1394S203020		X		
3.2.6.7.5.4	Process - TOD Loss On a Single Bus		IRD1394S204000				X
3.2.6.7.5.4	Process - TOD Loss On a Single Bus		IRD1394S204010				X
3.2.6.7.5.4	Process - TOD Loss On a Single Bus		IRD1394S204030				X

Paragraph	Title		Requirement ID	Verification Method			
				N	I	A	T
3.2.6.7.5.4	Process - TOD Loss On a Single Bus		IRD1394S204070				X
3.2.6.7.5.5	Process - TOD Loss On a Both Buses		IRD1394S205000				X
3.2.6.7.5.5	Process - TOD Loss On a Both Buses		IRD1394S205010				X
3.2.6.7.5.5	Process - TOD Loss On a Both Buses		IRD1394S205020				X
3.2.6.7.5.5	Process - TOD Loss On a Both Buses		IRD1394S205030				X
3.2.6.7.5.6.1	System Reset Responses		IRD1394S206120				X
3.2.6.7.5.6.1	System Reset Responses		IRD1394S206150				X
3.2.6.7.5.6.1	System Reset Responses		IRD1394S206160				X
3.2.6.7.5.6.1	System Reset Responses		IRD1394S206165				X
3.2.6.7.5.6.1	System Reset Responses		IRD1394S206170				X
3.2.6.7.5.6.3	Driver Reset Response		IRD1394S206300				X
3.2.7	Ports		IRD1394S207000		X		
3.2.7	Ports		IRD1394S207010		X		
3.2.7	Ports		IRD1394S207020		X		
3.2.7	Ports		IRD1394S207030		X		
3.2.8	IP Address Table		IRD1394S200560		X		
3.2.8	IP Address Table		IRD1394S200565		X		
3.2.8	IP Address Table		IRD1394S200575				X
3.2.8	IP Address Table		IRD1394S200580				X
3.2.8	IP Address Table		IRD1394S200585		X		
3.2.8	IP Address Table		IRD1394S200590				X
3.2.9	Packetization Summary		IRD1394S005990		X		
3.2.10	Network Fault Management		IRD1394S200600			X	X
3.2.10	Network Fault Management		IRD1394S200610			X	X
3.2.10	Network Fault Management		IRD1394S200620			X	X
3.2.10.1	Network Diagnosis		IRD1394S200630			X	X
3.2.10.1	Network Diagnosis		IRD1394S200640			X	X
3.2.10.1	Network Diagnosis		IRD1394S200650				X
3.2.10.1	Network Diagnosis		IRD1394S200660		X		
3.2.10.2	Fault Identification		IRD1394S200670			X	X
3.2.10.2	Fault Identification		IRD1394S200680				X

				Verification Method			
Paragraph	Title		Requirement ID	N	I	A	T
3.2.10.2	Fault Identification		IRD1394S200690				X
3.2.10.2.1	Detection of Host Port Failure		IRD1394S200691				X
3.2.10.2.1	Detection of Host Port Failure		IRD1394S200692				X
3.2.10.2.1	Detection of Host Port Failure		IRD1394S200693			X	
3.2.10.2.1	Detection of Host Port Failure		IRD1394S200694				X
3.2.10.2.2	Detection of System Failure		IRD1394S200695				X
3.2.10.2.2	Detection of System Failure		IRD1394S200697				X
3.2.10.3	Fault Isolation		IRD1394S200700			X	X
3.2.10.3	Fault Isolation		IRD1394S200710			X	X
0	Managed Network Reconfigurations		IRD1394S200730				X
0	Managed Network Reconfigurations		IRD1394S200740				X
0	Managed Network Reconfigurations		IRD1394S200750				X
0	Managed Network Reconfigurations		IRD1394S200760			X	
0	Managed Network Reconfigurations		IRD1394S200770				X
3.2.10.3.1	Suspend and Recover		IRD1394S200790				X
3.2.10.3.1	Suspend and Recover		IRD1394S200800		X		
3.2.10.3.3	Detection of Faults on Previously Suspended or Disabled Ports		IRD1394S200970				X
3.2.11	Time-Of-Day		IRD1394S006000				X
3.2.11.1	Time Code Data and Format		IRD1394S006010				X
3.2.11.2	Time Code Effectivity		IRD1394S006020				X
3.2.11.3	Time Code Data Epoch		IRD1394S006030		X		
3.2.11.4	Missing Time Code Data		IRD1394S006040				X
3.2.12	Commands			X			
3.2.12.1	Host Application Layer Command		IRD1394S208000				T
3.2.12.1	Host Application Layer Command		IRD1394S208010				T
3.2.12.2	Host Application Layer Table Load		IRD1394S210000				X
3.2.12.3	Network Manager Application Layer Commands			X			
3.2.12.4	Driver Commands		IRD1394S220005				X
3.2.12.4	Driver Commands		IRD1394S220010			X	
3.2.13	Telemetry			X			

Paragraph	Title		Requirement ID	Verification Method N	I	A	T
3.2.13.1	Host Application Layer Telemetry		IRD1394S220200				X
3.2.13.1	Host Application Layer Telemetry		IRD1394S220210				X
3.2.13.2	Network Manager Application Layer Telemetry		IRD1394S220300				X
3.2.13.2	Network Manager Application Layer Telemetry		IRD1394S220310				X
3.2.13.2	Network Manager Application Layer Telemetry		IRD1394S220320				X
3.2.13.2	Network Manager Application Layer Telemetry		IRD1394S220330				X
3.2.13.3	Driver Status Telemetry		IRD1394S220400				X
3.2.13.3	Driver Status Telemetry		IRD1394S220410				X
3.2.13.3	Driver Status Telemetry		IRD1394S220420				X
3.2.14	Logging		IRD1394S220500			X	
3.2.14	Logging		IRD1394S220510		X		
3.2.14	Logging		IRD1394S220520				X
3.2.14	Logging		IRD1394S220530				X
3.2.14	Logging		IRD1394S220540				X
3.2.14	Logging		IRD1394S220550		X		
3.2.14	Logging		IRD1394S220570				X
3.2.14	Logging		IRD1394S220580				X
3.2.14	Logging		IRD1394S220590		X		
3.2.14	Logging		IRD1394S220600				X
3.3	Performance		IRD1394S007000			X	X
3.3	Performance		IRD1394S007002			X	
3.3	Performance		IRD1394S007004			X	
3.3.1	Quality of Service			X			
3.3.1.1	Data Rate		IRD1394S007010				X
3.3.1.2	Bandwidth Allocation		IRD1394S007030			X	
3.3.1.3	Latency		IRD1394S007040			X	
3.3.1.3	Latency		IRD1394S007050			X	
3.3.1.4	Bit Error Rate (BER)		IRD1394S007060			X	
3.3.1.4	Bit Error Rate (BER)		IRD1394S007070			X	
3.3.1.4	Bit Error Rate (BER)		IRD1394S007080		X		
3.3.1.4	Bit Error Rate (BER)		IRD1394S007090			X	

				Verification Method			
Paragraph	**Title**		**Requirement ID**	**N**	**I**	**A**	**T**
3.3.1.5	Noise			X			
3.3.2	Availability			X			
3.3.2.1	Data Availability			X			
3.3.3	Time-of-Day			X			
3.3.3.1	Time Code Arrival timing		IRD1394S007110			X	
3.3.3.1	Time Code Arrival timing		IRD1394S007120				X
3.3.3.2	Time-of-Day Uncertainty With Time-of-Day Pulse		IRD1394S007130			X	
3.3.3.2	Time-of-Day Uncertainty With Time-of-Day Pulse		IRD1394S007140			X	
3.4	System Operations			X			
3.4.1	Normal Initialization		IRD1394S014000				X
3.4.1	Normal Initialization		IRD1394S014010				X
3.4.1	Normal Initialization		IRD1394S014020		X		
3.4.1	Normal Initialization		IRD1394S014030		X		
3.4.1.1	Power Application			X			
3.4.1.1.1	First Cable Power Application		IRD1394S014050				X
3.4.1.1.1	First Cable Power Application		IRD1394S014100			X	
3.4.1.1.1	First Cable Power Application		IRD1394S014200				X
3.4.1.1.1	First Cable Power Application		IRD1394S014500				X
3.4.1.1.2	Subsequent Power Application		IRD1394S015000				X

5 ACRONYMS AND ABBREVIATIONS

Acronym	Definition
APHY	Analog Physical Layer
APID	Application Process Identification
1394 ARP	Address Resolution Protocol (specific to FT1394)
AWG	American Wire Gauge
C&DH	Command & Data Handling
CCA	Circuit card assembly
CCSDS	Consultative Committee for Space Data System
CMIS	Conical Microwave Imager/Sounder
CrIS	Crosstrack Infrared Sounder
CP_PDU	CCSDS Path Protocol Data Unit
CSR	Control and status register
dB/m	Decibels per meter (cable shielding effectiveness)
DPHY	Digital Physical Layer
DSU	Data Server Unit
EDR	Environmental Data Record
EUI-64	Extended Unique Identifier, 64-bits
FIFO	First In – First Out Memory
GIID	General Instrument Interface Document
ICD	Interface Control Document
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IOO	Host of Opportunity
IP	Internet protocol (within this document, IPv4)
IRD	Interface Requirement Document
LSB	Least Significant Bit
Mbps	Megabits per second
MCAP	Multicast channel allocation protocol
MSB	Most Significant Bit
NI	Network Interface

NPOESS	National Polar-Orbiting Operational Environmental Satellite System
PHY	Physical Layer
PSP	Payload Support Processor
RDR	Raw Data Record
RF	Radio Frequency
RFC	Request for Comment (IETF specifications)
SC	The NPOESS Spacecraft
SCP	Spacecraft Control Processor
TBD	To be determined
TBS	To be supplied
TBR	To be revised
TDR	Time Domain Reflectometry
UDP	User Datagram Protocol
VIIRS	Visible Infrared Imager/Radiometer Suite

5.1 Definitions

The terms FT1394 Bus, FT1394 Node, LINK, PHY, and Port, as well as other FT1394 bus nomenclature shall be as defined in IEEE 1394-1995 specification.

1394 Bus-Reset	When a 1394 Bus-Reset occurs, all pending data transfers are cancelled and the bus topology is rebuilt. A 1394 Bus-Reset is triggered either by internal PHY state machine logic or by a bit being set in the relevant PHY register. A 1394 bus reset consists of three phases: bus initialization, tree identify, and self identify as defined in IEEE 1394 a-1995 and amended in IEEE 1394a-2000. Following the start of a 1394 Bus-Reset, the 1394 LLC: Discards all pending transactions, Flushes the asynchronous transmit context, Inserts a synthesized bus reset packet into the asynchronous receive context, Discards all pending physical requests, Sets relevant PHY and CSR registers to their default values, Clears the topology information associated with each port.
1394 Packet:	Any of the FT1394 primary packets; these may be read, write or lock requests (and their responses) or stream data. The term "packet" is used consistently to differentiate Serial Bus primary packets from FT1394 ARP requests/responses, IP Datagrams or MCAP advertisements/solicitations.
AOS	Advanced Orbiting Systems: A CCSD term for any space asset incorporating CSSDS protocol.
APHY:	Analog Circuit portion of the PHY Layer
ARP	Address Resolution Protocol: A method for a requester to determine the hardware (1394) address of an IP node from the IP address of the node.
Asynchronous:	Transfers variable length data and transaction layer packet to an explicit address. Acknowledgment is returned.
Auxiliary Data	Data required for processing the science/observed mission data into SDRs and EDRs.
Bus ID:	A 10-bit number that uniquely identifies a particular bus within a group of multiple interconnected buses. The bus ID is the most significant portion of a node's 16-bit node ID. The value 0x3FF designates the local bus; a node SHALL respond to requests addressed to its 6-bit physical ID if the bus ID in the request is either 0x3FF or the bus ID explicitly assigned to the node.
Byte:	The computer term for eight (8) digital data bits.
CCSDS octet:	The CCSDS term for eight (8) digital data bits also known as a byte.
CCSDS Packet Segment:	A CCSDS formatted chunk of data that requires other packet segments to compete the packet set.
CCSDS Packet Set	The total set of packet segments (always more than one) in a CCSDS formatted data transfer where the data is larger than a single packet permits.
CCSDS Packet:	A single CCSDS formatted chunk of data that may be complete unto itself or a part of the total Data Set to be transferred.

Chunk:	A contiguous set of bits, not CCSDS formatted.
Data Set:	Multiple packets or packet segments that make up a single transfer.
Datagram:	One way FT1394 data packet transfer
DPHY:	Digital circuit portion of the PHY Layer
Driver	The software that interfaces the network interface card to the application layer software
Driver Initialization/Re-initialization	Driver Re-initialization occurs when application software uses the relevant driver API call. The application software may reinitialize the driver under a variety of conditions; see the section on System Reset Types. When Driver Re-initialization occurs, the following actions are performed: a Driver Reset is used to reset the driver; an LLC Soft Reset is used to soft reset the LLC; and a 1394 Bus-Reset is triggered to enable data transmission and reception.
Driver Reset	A Driver Reset restores the IP-over-1394-driver to its post-initialization configuration. When a Driver Reset occurs: all networking layer interconnections are detached; all dynamic buffers and OHCI descriptors are returned to their respective pools, except for buffers that are still in use by application software; all data structures are reset to their default values; and finally the layer interconnections are re-attached. A Driver Reset is triggered by an API function call, and is used as part of the overall driver re-initialization process.
Encapsulation header:	A structure that precedes all IP data transmitted over FT1394. See also link fragment.
Epoch:	The point in time, represented by a pre-specified indicator, where an event is to occur or data is to become effective.
File:	A set of inter-related data stored, processed or communicated as a single unit.
FT1394 Bus:	A collection of 2 or more FT1394 nodes connected together
FT1394 Node (or node)	An addressable device attached to the FT1394 serial bus with at least the minimum set of control registers.
Ground	Two Meanings: 1: electrical ground 2: The ground system including the MMC, C3, IDPS and terminals
Ground or Stored Command	The operations team may use a real-time or stored ground command to reset the 1394 bus in an attempt to correct an anomaly.
Hardware or Software Anomaly	The driver on each host may detect an error in either the driver itself or the 1394 hardware. If such an error is detected, then the host may reinitialize the driver and hardware in an attempt to correct the error condition.

Host	Any unit that receives or transmits data via the FT1394 network. A Host is any unit containing a NI with associated software Driver to implement attachment to the FT1394 network.
Host Bus Configuration	Socket creation, Dbuff configuration, etc
Host_1394 Initialization/Re-initialization	Occurs as a result of power application to a host or the detection of various fault conditions detected through missing TOD packets.
IP	Internet Protocol: A set of protocols defined by the IETF.
IP Datagram:	An Internet message that conforms to the format specified by STD 5, RFC 791.
Isochronous:	Broadcasts variable length data based on channel numbers rather than specific addressing. Isochronous packets are issued on the average of each 125 µ in support of time-sensitive applications.
LINK (Link Layer)	The layer that provides the service to the transaction layer of data transfers with the confirmation of reception. Also provides addressing, data checking, data framing and isochronous data transfer service.
Link Fragment:	A portion of an IP Datagram transmitted within a single FT1394 packet. The data payload of the FT1394 packet contains both an encapsulation header and its associated link fragment. It is possible to transmit Datagrams without link fragmentation.
LLC Hard Reset	An LLC Hard Reset is similar to the LLC Soft Reset, except that in addition to the soft reset effects: the PCI registers are reset to their default registers; the PCI state machines are reset; and the LLC PROM is reloaded. An LLC Hard Reset is trigged when the pci_rst_n pin is driven low; this pin is wired to the reset signal on the PCI bus. As with an LLC Soft Reset, software must perform a 1394 Bus-Reset before the LLC can transmit or receive 1394 data; however, the node will still act as a repeater because PHY operation is unaffected
LLC Soft Reset	When the LLC chip is soft reset: all data transfers through the LLC are halted; all internal FIFO's are flushed; all OHCI registers are reset to their default values; all internal 1394 state machines are reset; and the LLC side of the LLC / PHY interface is reset (the PHY side of the interface is not reset because the LPS signal is pulled high). An LLC Soft Reset is triggered by a bit being set in the HCControl register; the bit is cleared when the LLC completes the soft reset. An LLC Soft Reset does not affect the LLC's PCI registers and state machines. Following an LLC Soft Reset, software must perform a 1394 Bus-Reset before the LLC is capable of transmitting or receiving data on the 1394 bus; the bus reset is required in order to build the topology map. After the LLC Soft Reset but before the software triggers a bus reset, the node will still act as a repeater because PHY operation is unaffected.
MCAP	Multicast Channel Allocation Protocol: A method for multicast groups to coordinate their use of Serial Bus resources (channels) if multicast Datagrams are transmitted on other than the default broadcast channel.

MCO — Multicast Channel Owner: A multicast source that has allocated a channel for one or more multicast addresses and transmits MCAP advertisements to communicate these channel mapping(s) to other participants in the IP multicast group. When more than one source transmits MCAP advertisements for the same channel number, the source with the largest physical ID is the owner.

MTU — The Maximum Transmission Unit specifies the maximum amount of data that the sub network layer will accept in a single sub network service request or transfer. An MTU size is driven by the smallest allowable MTU in the data path.

Near Simultaneous — Near simultaneous means that multiple things occur in time within a period shorter than the execution time of any of the individual items. Where there is a single serial port it might refer to having a second packet set input begin before the first has completed execution. It may also mean that multiple input APIDs packet sets may arrive together with individual packet segments arriving randomly related to the APIDs until all packet sets are received.

Network Byte Order: The order in which the bytes of a word are transmitted. For a 32-bit word; O1, O2, O3, O4, where O1 is the most significant CCSDS octet, O1 is transmitted first, O2 next, then O3, and finally O4. The same applies for any modulo 8-bit tuple.

Network Interface Card — A network interface card provides a modular hardware interface to a network or data bus.

Node — A tri-port 1394 interface. The layer that translates the logical symbols used by the link layer into electrical signals. Each node consists of three ports connected to a PHY and a Link.

Node ID: A 16-bit number that uniquely identifies a Serial Bus node within a group of multiple interconnected buses. The most significant ten bits are the bus ID and the least significant six bits are the physical ID.

Node Unique ID: A 64-bit number that uniquely identifies a node among all the Serial Bus nodes manufactured worldwide; also known as the EUI-64 (Extended Unique Identifier, 64-bits).

Octet: Eight bits of data.

PCI Bus-Reset — A PCI Bus-Reset occurs when the SBC asserts the PCI reset signal. This will occur both when PCI power is first applied to the 1394 NI, and when a PCI fault is detected. In either case, the SBC must either initialize or reinitialize the IP-over-1394 hardware and driver before data may be transmitted or received on the 1394 bus. When a PCI Bus-Reset occurs, the following actions are performed: An LLC Hard Reset is used to hard reset the LLC; a Driver Reset is used to reset the driver; an LLC Soft Reset is used to soft reset the LLC; and a 1394 Bus-Reset is triggered to enable data transmission and reception. Note that both soft and hard LLC resets occur because the soft reset is a standard element of the driver initialization or re-initialization process.

PHY — (Physical Layer):

PHY Bus-Reset — A PHY Bus-Reset occurs when the DPHY's internal logic detects one of the following conditions: power is first applied to the PHY; the connection state changes for any port on the PHY; or a maximum arbitration state timeout occurs. A connection state change may result either from cable power being applied or removed, or from a connected port being disabled or enabled. Currently, a connected port being enabled will not trigger a bus reset, (likely due to a problem with the APHY connection detection circuitry.) The effect of a PHY Bus-Reset is that a 1394 Bus-Reset is triggered by the PHY.

PHY Reset	When the DPHY chip is reset, all internal registers are reset to their default values, and all internal state machines are reset. A PHY Reset is triggered when the nRESET pin on the DPHY is driven low.
Physical ID:	On a particular bus, this 6-bit number is dynamically assigned during the self-identification process and uniquely identifies a node on that bus.
Port:	A physical entity in a node that connects to a cable and provides one end of a physical connection with another node. A single port provides bi-directional signaling over a 6-wire point-to-point path (TPA/TPB) with another port in another node.
Quad Tri Port (Dual Redundant)	Having two tri-port nodes for the primary unit side and two for the redundant (standby) unit side for a total of four nodes.
Quadlets:	Four octets, or 32 bits, of data.
Repeater	A Repeater is a Node without a LINK.
Root	A special Host with the responsibility for managing the FT1394 network including fault management.
Segmented	Data subdivided into multiple CCSDS packets, called CCSDS packet segments, thus comprising a CCSDS packet set.
Software_Bus_Reset	A Software Bus-Reset occurs when application software uses a driver API call to set a bit in the appropriate PHY register. Application software may initiate a software bus reset under a variety of conditions; see the section on System Reset Types. When the appropriate bit is set, the PHY triggers a 1394 Bus-Reset.
Stream Packet:	A FT1394 primary packet with a transaction code of 0x0A that contains a block data payload. Stream packets may be either asynchronous or isochronous according to the type of FT1394 arbitration employed.
Systemic Anomaly	A node on the 1394 bus may detect an error in the data system and initiate a reset as a result. For example, the SCP monitors the health of other hosts on the 1394 bus using periodic ICMP pings. If a host on the network stops responding to these ICMP pings, the SCP may reset the 1394 bus in an attempt to restore connectivity to the host. Also, when the SCP powers on a host on the bus, the host will reset the 1394 bus. Finally, if a host stops receiving TOD updates, it may reinitialize its driver in an attempt to restore connectivity. See the specific requirement table for a full list of systemic anomalies and responses
Tri-Port:	Three physical connection ports each providing bi-directional signaling over a 4-wire point-to-point path (TPATPB*/Vp-g) with another port in another node and with each other, and interconnection to the local PHY layer
Tuple:	A tuple is an ordered set of arbitrary length.
UDP	User Datagram Protocol: An Internet message that conforms to the format specified by RFC 768.

Word: The computer term for sixteen (16) digital data bits or two (2) bytes or two (2) CCSDS octets.

6 APPENDIX A: NPP SPACECRAFT EXCEPTIONS

The NPP Satellite will also utilize the 1394 Network, however, certain design implementation differences exist. The following tables and figures describe known differences between the NPP Spacecraft 1394 topology and the NPOESS design. This information was provided by BATC and GSFC to document their exceptions to this specification. The GSFC/BATC NPP Program is responsible for the accuracy of this information and the NPP spacecraft system performance.

In order to simplify comparison of information, BATC has labeled the tables and figure below with the same designator and added a B at the end. For example, Figure 3.1.3-1B below is the NPP equivalent of Figure 3.1.3-1 on page 10 above.

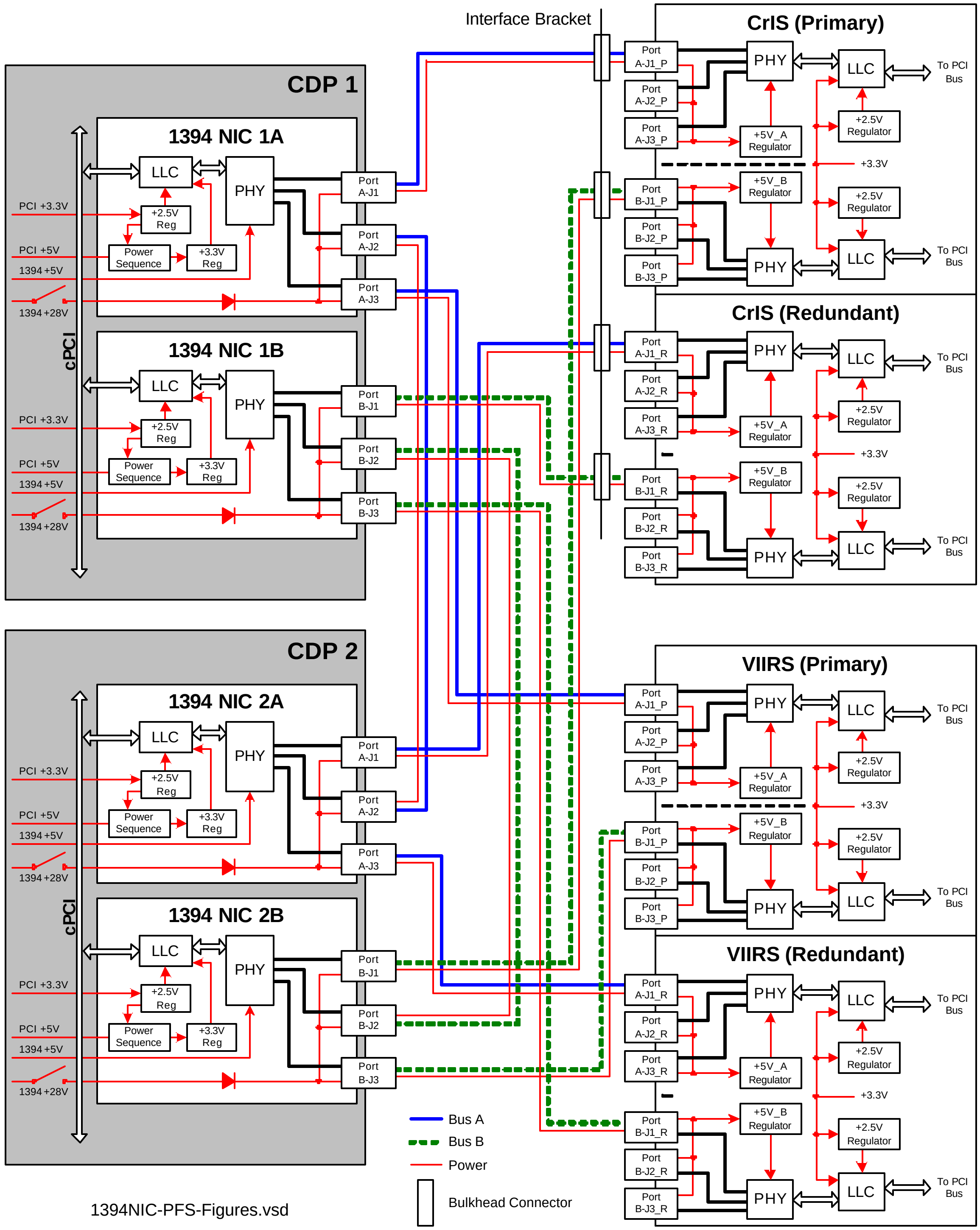

Figure 3.1.3-1B: NPP FT1394 Topology

Table 3.2.2-1B: Arbitration Priority

Priority	Host	1394 Physical Packet Size (quadlets)
2 (***BATC TBR***)	CrIS	128 (***NGST TBR***)
2 (***BATC TBR***)	VIIRS	128 (***NGST TBR***)
2 (***BATC TBR***)	CDP	128 (***NGST TBR***)

Table 3.2.8-2B: Default IP Addressing

		Bus A				Bus B			
CDP	P	172	:015	:001	:006	172	:016	:001	:006
CDP	R	172	:015	:001	:007	172	:016	:001	:007
CDP*	P	172	:015	:001	:004	172	:016	:001	:004
CDP*	R	172	:015	:001	:005	172	:016	:001	:005
VIIRS	P	172	:015	:001	:112	172	:016	:001	:112
VIIRS	R	172	:015	:001	:113	172	:016	:001	:113
CrIS	P	172	:015	:001	:122	172	:016	:001	:122
CrIS	R	172	:015	:001	:123	172	:016	:001	:123
Broadcast	X	172	:015	:255	:255	172	:016	:255	:255

*NOTE - The CDP will use IP multi-homing to map the CDP to the NPOESS SCP and DSU IP addresses.

		TMON	HK	Eng	Science	CAL	Diag	Dwell	CMDs	Broadcast
FROM		TO								
CDP P	IP Address	NA	NA	NA	NA	NA	NA	NA	Any	
	Port #	NA	NA	NA	NA	NA	NA	NA	Brdcst	Brdcst
CDP R	IP Address	NA	NA	NA	NA	NA	NA	NA	Any	
	Port #	NA	NA	NA	NA	NA	NA	NA	Brdcst	Brdcst
VIIRS P	IP Address	CDP P	CDP* P	CDP* P	CDP* P	CDP* P	CDP* P	CDP* P	NA	NA
	Port #	TMON	HK/LEOA	TLM	TLM	TLM	TLM	TLM	NA	NA
VIIRS R	IP Address	CDP P	CDP* P	CDP* P	CDP* P	CDP* P	CDP* P	CDP* P	NA	NA
	Port #	TMON	HK/LEOA	TLM	TLM	TLM	TLM	TLM	NA	NA
CrIS P	IP Address	CDP P	CDP* P	CDP* P	CDP* P	CDP* P	CDP* P	CDP* P	NA	NA
	Port #	TMON	HK/LEOA	TLM	TLM	TLM	TLM	TLM	NA	NA
CrIS R	IP Address	CDP P	CDP* P	CDP* P	CDP* P	CDP* P	CDP* P	CDP* P	NA	NA
	Port #	TMON	HK/LEOA	TLM	TLM	TLM	TLM	TLM	NA	NA

Table 3.2.8-3B: NPP Data Types to IP Address Relationships

		TMON	HK	Eng	Science	CAL	Diag	Dwell	CMDs	Broadcast
FROM		TO								
CDP P	IP Address	NA	NA	NA	NA	NA	NA	NA	Any	172.15.255.255
	Port #	NA	NA	NA	NA	NA	NA	NA	10001	10031
CDP R	IP Address	NA	NA	NA	NA	NA	NA	NA	Any	172.15.255.255
	Port #	NA	NA	NA	NA	NA	NA	NA	10001	10031
VIIRS P	IP Address	172:15:1:6	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	NA	NA
	Port #	10002	10004	10008	10008	10008	10008	10008	NA	NA
VIIRS R	IP Address	172:15:1:6	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	NA	NA
	Port #	10002	10004	10008	10008	10008	10008	10008	NA	NA
CrIS P	IP Address	172:15:1:6	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	NA	NA
	Port #	10002	10004	10008	10008	10008	10008	10008	NA	NA
CrIS R	IP Address	172:15:1:6	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	172:15:1:4	NA	NA
	Port #	10002	10004	10008	10008	10008	10008	10008	NA	NA

Table 3.2.8-4B: NPP Data Types to IP Address Relationship Default

Table 3.3.1-1B: Network CCSDS Traffic Conditions (Mbps) including 50% margin

Case #	Specified relative to user		VIIRS	CrIS	CDP (Root)
1	Bus A	Input	0.386	0.386	20.340
		Output	15.838	4.502	0.386
	Bus B	Input	0.386	0.386	0.000
		Output	0.000	0.000	0.386
2	Bus A	Input	0.386	0.386	0.000
		Output	0.000	0.000	0.386
	Bus B	Input	0.386	0.386	20.340
		Output	15.838	4.502	0.386

Highlighted Cells - Denotes exceptions that are in-work/open, or have open action items against them

Table 6.1: BATC comments/questions/exceptions to the NPOESS FT1394 System IRD

D34471, Rev A (Oct 29, 2003)

ID	Section	Sec Title	Requirement #	Requirement Wording	BATC Question/Comment/Exception	Exception/ Comment	BATC/NPP alternative requirement / wording
1	3.1.1	System Configuration		2nd paragragh	The second paragraph describes the NPOESS ring topology. Although not a requirement, this description does not apply to NPP/BATC 1394 topology.	Exception	Each NPP 1394 bus is implemented as a stacked tree.
2	3.1.3.1	Physical Topology	IRD1394S000400	The physical topology for the NPOESS FT1394 network shall be two ring buses as shown in Figure 3.1.3-1.	N/A to BATC/NPP. No ring topology. Reqt can be replaced with NPP specific topology description and NPP specific figure.	Exception	The physical topology for the NPP FT1394 networks shall be two modified stacked tree buses as shown in Figure 3.1.3-1B.
3	3.1.3.2	Logical Topology	IRD1394S000450	The logical topology for the NPOESS FT1394 Serial Bus shall be a cyclic network with finite branches and extent having one path in each serial bus broken between two Nodes such that it is "acyclic" during normal operations.	N/A to NPP	Exception	[No alternate wording.]
4	3.1.3.2	Logical Topology	IRD1394S000460	When the ring (physical topology) is broken in one place, it shall be done such that the cable power remains intact.	N/A to NPP	Exception	[No alternate wording.]
5	3.1.3.3	Nodes	IRD1394S000530	Active ports shall support the bus repeater function regardless of the power state or mode of their Host unit as long as cable power is present.	N/A to BATC/NPP. NPP CDP Physical layers do not get power from the cable. The CDP PHYs can be powered independent of the Host power. The CDP PHY power comes thru the backplane rather than the cable. Therefore, the CDP being operated as a repeater will be powered independant of cable power.	Exception	[No alternate wording.]
6	3.1.3.3.2	Root Node	IRD1394S000730	Both system Root Node capable Hosts shall be the SCP, one in the prime SCP and one in the redundant SCP.	SCP is NPOESS specific unit. Replace with “CDP” for BATC/NPP	Exception	Both system Root Node capable Hosts for NPP shall be the CDP, one in the prime CDP and one in the redundant CDP.
7	3.1.3.3.2	Root Node	IRD1394S000760	All inactive Root Nodes shall be active Host nodes.	BATC cannot accommodate this capability. Cannot have both CDPs powered simultaneously. The inactive Root (redundant CDP) will function as a repeater, but not an active Host (ie- processor is not powered)	Exception	[No alternate wording.]
8	3.1.3.3.2	Root Node	IRD1394S000770	All Root Nodes shall be simultaneously powered (hot-backup)	BATC cannot accommodate this capability. Cannot have both CDPs powered simultaneously.	Exception	[No alternate wording.]
9	3.1.3.3.3	Host Nodes	IRD1394S000950	Each NIC shall include 2 nodes	BATC/NPP root NICs will have single node per NIC. Reword for NPP or exception.	Exception	[No alternate wording.]
10	3.1.3.3.3	Host Nodes		Descriptions of DSU, SCP, PSP, etc.	NPOESS specific. N/A to NPP. Non-requirement	Exception	CDP: Command and Data Processor serves as the source of all commands, Time-of-Day messages, acts as the Network Manager and Root Node, and receives all data to be formatted and sent to the ground for NPP.
11	3.1.3.3.3	Host Nodes		Figure 3.1.3-1 NPOESS FT1394 Topology	Replace with NPP specific figure. N/A to NPP	Exception	[See NPP/BATC provided Figure 3.1.3-1B]
12	3.1.3.3.6	Maximum Physical Stream	IRD1394S001200	The system, as designed and implemented, shall be capable of operating with or without the Spare Host in the network.	N/A to BATC/NPP. NPOESS topology specific reqts	Exception	[No alternate wording.]

13	3.1.3.3.6	Maximum Physical Stream	IRD1394S001210	The system, as designed and implemented, shall be capable of operating with or without the TestHost in the network.	N/A to BATC/NPP. NPOESS topology specific reqts	Exception	[No alternate wording.]
14	3.1.3.3.6	Maximum Physical Stream	IRD1394S001220	The system shall support the maximum to the minimum physical spacecraft layout that can be constructed using the elements of this document.	N/A to BATC/NPP. NPOESS topology specific reqts	Exception	[No alternate wording.]
15	3.1.3.3.6	Maximum Physical Stream	IRD1394S001230	The system shall meet data transmission requirements independent of Host location or logical ring break location.	N/A to BATC/NPP. NPOESS topology specific reqts	Exception	[No alternate wording.]
16	3.1.3.3.9	Expandability	IRD1394S001400	Each 1394 Serial Bus shall be expandable to include up to 16 nodes	N/A to BATC/NPP due to our power supply design/sizing	Exception	Each NPP 1394 Serial Bus shall be expandable to include up to 4 nodes. *Two nodes on the prime CDP and 2 on the redundant CDP.*
19	3.1.3.6	Node Operational Redundancy	IRD1394S001730	All Phys (physical layers) shall be powered from the FT1394 interface cable connector, even when the Host unit, prime or redundant, is unpowered.	N/A to BATC/NPP. NPP CDP Physical layers do not get power from the cable. The CDP PHYs can be powered independent of the Host power. The CDP PHY power comes thru the backplane rather than the cable.	Exception	[No alternate wording.]
20	3.1.3.6	Node Operational Redundancy	IRD1394S001750	The FT1394 system Network Manager shall be designed to be hot standby such that only one is in active control of the FT1394 network but both shall be powered unless there is a failure.	N/A to BATC/NPP. NPP CDPs do not support hot standby (see #10). Hot standby capability for the NPP Network Manager is not required to meet mission requirements,	Exception	[No alternate wording.]
21	3.1.3.6	Node Operational Redundancy	IRD1394S001760	The hot-standby Root Nodes shall operate as any other Host nodes on the FT1394 network.	N/A to BATC/NPP. NPP CDPs do not support hot standby (see #10). Hot standby capability for the NPP Network Manager is not required to meet mission requirements,	Exception	[No alternate wording.]
22	3.1.3.7	Gap Time	IRD1394S001920	Physical pinging shall be used for final gap count setting	BATC may open-loop set the final gap count, rather than using physical pinging.	Exception	[No alternate wording.]
23	3.2.1.2.2.1	Bus Reset	IRD1394S002270	Following a bus reset the root node shall logically break the physical ring by commanding a node to suspend.	NPOESS specific. N/A to NPP. BATC does not intend to use a ring like topology and therefore will not test the ability to break a ring topology.	Exception	[No alternate wording.]
24	3.2.1.2.2.1	Bus Reset	IRD1394S002300	The bus-reset……as required by IEEE Standard 1394a-2000. [NI]	Requirement should be levied upon [Driver]	Comment	
25	3.2.1.2.2.2	Tree Indentify	IRD1394S002400	The Root Nodes shall logically break physical loops	NPOESS specific. N/A to NPP. BATC does not intend to use a ring like topology and therefore will not test the ability to break a ring topology.	Exception	[No alternate wording.]
26	3.2.1.3.1	Cycle Master	IRD1394S002500	Only the spacecraft shall act as the serial bus cycle master.	Cycle master is only associated with isochronous mode.Tech IRD (sec. 3.4.2.3.1) specifically prohibits isochronous. BATC does not intend to use nor to test isochronous. N/A to BATC/NPP	Exception	[No alternate wording.]
27	3.2.1.3.3	Isochronous Resource Manager	IRD1394S002550	Only the spacecraft shall act as the isochronous resource manager.	Tech IRD (sec. 3.4.2.3.1) specifically prohibits isochronous. Why have reqts for a prohibited function? BATC does not intend to use nor to test	Exception	[No alternate wording.]

					isochronous. N/A to BATC/NPP		
29	3.2.2.1	Transaction Scheme	IRD1394S002900	Request for arbitration shall begin the process for each CCSDS packet with priority request shown in Table 3.2.2-1	Table is N/A to NPP (CDP, CrIS, VIIRS). Also, NPP may want different priority settings.	Exception	Request for arbitration shall begin the process for each CCSDS packet with priority request shown in Table 3.2.2-1B
30	3.2.2.1	Transaction Scheme	IRD1394S002910	The Network Manager shall command the priority of request per Table 3.2.2-1	Table is N/A to NPP (CDP, CrIS, VIIRS). Also, NPP may want different priority settings.	Exception	The Network Manager shall command the priority of request per Table 3.2.2-1B
31	3.2.2.1	Transaction Scheme		Table 3.2.2-1 Arbitration Priority	N/A to NPP. NPP may want/need different priority settings.		[See NPP/BATC provided Table 3.2.2-1B]
32	3.2.3.4.1	Finished Cables	IRD1394S003220	The spacecraft cable system shall be sufficiently shielded to prevent energy leakage that may cause electromagnetic interference (EMI) in compliance with the RS and RE EMI requirements in D31418.	D31418 (Latest) is not applicable to BATC. BATC is on contract to the Aug 6, 2001 NPOESS/NPP GIID and GSFC NPP EMI specification.	Exception	The spacecraft cable system shall be sufficiently shielded to prevent energy leakage that may cause electromagnetic interference (EMI) in compliance with the BATC Environmental Design and Test Specification (EDTS) for Spacecraft Components- NPP, BATC Dwg. 568349
33	3.2.3.4.1	Finished Cables	IRD1394S003260	The cable shall withstand all of the environmental requirements for the duration of the mission per D31418.	D31418 (Latest) is not applicable to BATC. BATC is on contract to the Aug 6, 2001 NPOESS/NPP GIID and GSFC NPP EMI specification.	Exception	The cable shall withstand all of the environmental requirements for the duration of the mission per BATC Environmental Design and Test Specification (EDTS) for Spacecraft Components- NPP, BATC Dwg. 568349
34	3.2.3.4.2	Connector Designations	IRD1394S003300	Each connector group of three ports on the Host shall be designated and marked for connection matching Figure 3.2.3-1 and lettered with an A or a B for the associated Bus.	N/A to BATC/NPP. BATC has alternative standard method for uniquely identifying connectors/cables	Exception	[No alternate wording.]
35	3.2.3.4.2	Connector Designations	IRD1394S003310	Each cable end connector shall have a color-coded band matching Figure 3.2.3-1 /Figure 3.2.3-2 and lettered with an A or a B for the associated bus.	N/A to BATC/NPP. BATC has alternative standard method for uniquely identifying connectors/cables	Exception	[No alternate wording.]
36	3.2.3.4.2	Connector Designations		Figure 3.2.3-1 Host NIC Connector Labeling	N/A to BATC/NPP. BATC has alternative standard method for uniquely identifying connectors/cables	Exception	[No alternate wording.]
37	3.2.3.4.2	Connector Designations		Figure 3.2.3-2 Cable-End Labeling	N/A to BATC/NPP. BATC has alternative standard method for uniquely identifying connectors/cables	Exception	[No alternate wording.]
38	3.2.3.4.3	Connectors	IRD1394S003360	Connectors shall be qualified in the design implementation to meet the D31418.	D31418 is N/A to BATC/NPP. This says that the connector in the BATC design implementation (the CDP) must be tested / qualified to D31418. BATC is testing to our EDTS which is based on the EMI requirements originally levied in the GSFC EMI Spec. May need to bounce the EDTS levels against the D31418 (NGIID).	Exception	Connectors shall be qualified in the design implementation to meet the BATC Environmental Design and Test Specification (EDTS) for Spacecraft Components- NPP, BATC Dwg. 568349
39	3.2.3.4.4	Connector Identification	IRD1394S003460	Connector installation shall reduce the probability of misconnection by color-coding both the cable mounted and unit mounted connectors, on the Host surface near or surrounding the conector per Table 3.2.3-1.	N/A to BATC/NPP. BATC has alternative standard method for uniquely identifying connectors/cables	Exception	[No alternate wording.]
40	3.2.3.4.4	Connector Identification		Table 3.2.3-1 Connector Identification	N/A to BATC/NPP. BATC has alternative standard method for uniquely identifying connectors/cables	Exception	[No alternate wording.]

41	3.2.3.4.6	Bulkhead Feed Through Connectors	IRD1394S003480	Connectors implemented to cross thru bulkheads or traverse mechanical structures in the spacecraft shall meet all RS and RE EMI requirements in the D31418.	D31418 (Latest) is not applicable to BATC. BATC is on contract to the Aug 6, 2001 NPOESS/NPP GIID and GSFC NPP EMI specification.	Exception	Connectors implemented to cross thru bulkheads or traverse mechanical structures in the spacecraft shall meet all RS and RE EMI requirements in the BATC Environmental Design and Test Specification (EDTS) for Spacecraft Components- NPP, BATC Dwg. 568349
42	3.2.3.5	1394 Electrical Interface	IRD1394S003500	The FT1394 Bus signal and power interface characteristics shall meet all electrical requirements of the IEEE 1394 S100 Serial Bus as specified in the IEEE 1394-1995, IEEE 1394a-2000, and D31418.	1) How do you verify a general requirement like this ?(The verf matrix says that verification is done by Inspect and Analysis). 2) D31418 (Latest) is not applicable to BATC.	Exception	[No alternate wording.]
43	3.2.3.6.1	Cable Power	IRD1394S003600	The Physical layer (all portions) shall derive power from the FT1394 cable.	N/A to BATC/NPP. BATC meets the intent, but has a different implementation that does not power the Phys from the cable power source (separate PHY power via backplane).	Exception	[No alternate wording.]
44	3.2.3.6.1	Cable Power	IRD1394S003610	Power from the cable shall be used for the physical layer only and shall be isolated from other circuits	N/A to BATC/NPP. BATC meets the intent, but has a different implementation that does not power the Phys from the cable power source (separate PHY power via backplane). PHY power is isolated from other Host power.	Exception	[No alternate wording.]
45	3.2.3.6.1	Cable Power	IRD1394S003630	Physical Layer power to the physical layer interface and logic circuits shall be un-powered when the cable is un-powered.	N/A to BATC/NPP. BATC meets the intent, but has a different implementation that does not power the Phys from the cable power source (separate power via backplane).	Exception	[No alternate wording.]
46	3.2.3.6.1	Cable Power	IRD1394S003640	No single failure within a Host NIC shall be permitted to source unit supplied power onto the FT1394 cable.	N/A to root nodes. BATC/NPP CDP (root) is the cable power source. This is different than the NPOESS architecture where an external source is providing cable power This should be specified as a instrument Host reqt only (or N/A to Root Node Hosts)	Exception	[No alternate wording.]
47	3.2.3.6.2	Cable Power Distribution	IRD1394S003720	Power drawn from the cable for each node shall under normal conditions be less than of equal to 275 milliamps peak while voltage is between 22 to 38.6 volts.	BATC design supports 250 milliamps. Previous reqt was 150 mA. Got a verbal that reqt was changing to 250 mA. 275 mA would require power supply re-design.	Exception	Power drawn from the cable for each node shall under normal conditions be less than of equal to 250 milliamps peak while voltage is between 26 to 30 volts.
48	3.2.3.6.2	Cable Power Distribution	IRD1394S003725	Power drawn from the cable for each node shall not exceed under other than normal conditions 400 milliamps while voltage is between 22 to 38.6 volts.	New reqt. Is the 1394 system supposed to continue operating normally and meeting performance requirements under these abnormal conditions or simply survive them without permanent degradation?? BATC power supply will fold back and limit the current by reducing the voltage, but this may mean that the power/voltage requirements are not met.	Exception	
49	3.2.3.6.3	Cable Power Source	IRD1394S003820	Cable power input shall contain a common system power filter meeting the D31418	D31418 (Latest) is not applicable to BATC. BATC is on contract to the Aug 6, 2001 NPOESS/NPP GIID and GSFC NPP EMI specification.	Exception	Cable power input shall contain a common system power filter meeting the BATC Environmental Design and Test Specification (EDTS) for Spacecraft Components- NPP, BATC Dwg. 568349
50	3.2.3.6.3	Cable Power Source		Table 3.2-3 Cable Power Specification	BATC power supply is designed to support 1A. Will required power supply redesign to meet the 3A current requirement.	Exception	Table 3.2-3 Cable Power Specification: Maximum network series bus current = 1.0 Adc
51	3.2.3.7	Grounding	IRD1394S004170	The system shall return each cable ground to spacecraft single point ground through a command mode power filter.	NPOESS specific power implementation. NPP provides regulated power via a discrete power supply, therefore the cable power is a secondary voltage and the ground does not return directly to single point ground.	Exception	[No alternate wording.]
52	3.2.3.8.1	Faults	IRD1394S200210	No single credible failure within the NIC shall be capable of causing the permanent removal of power from any two nodes including the source of the failure.	N/A to NPP. NPP topolgy does not have multiple paths to each node.	Exception	[No alternate wording.]

53	3.2.3.8.1	Faults	IRD1394S200220	No single credible failure within the spacecraft shall be capable of causing the permanent removal of power from any two nodes including the source of the failure.	N/A to NPP. NPP topolgy does not have multiple paths to each node.	Exception	[No alternate wording.]
54	3.2.6.1.3	Content and Structure	IRD1394S004620	Sub-commutation within a telemetry APID shall be employed when a single CCSDS packet is too large	NOTE to GSFC- NPP cannot perform Tmon function on sub-comm data. May need to revisit, reword, or remove Tmon on instr. Housekeeping TLM and limit it to instr. Tmon packet only.	Comment	*NPP spacecraft cannot perform Tmon function on sub-comm data.*
55	3.2.6.1.4.1	Telecommand CRC Usage	IRD1394S004800	The usage…..Host provider. [Host] The spacecraft…..to use checksum.	Wording after "[Host}" should be in italics	Comment	
56	3.2.6.1.5.6	Command APIDs	IRD1394S004950	Each host shall have two (2) APIDs for commands.	Current baseline for BATC/NPP does not differentiate between ground and S/C commands. This may simply be accomplished by the ground system.	Exception	[No alternate wording.]
57	3.2.6.1.5.7	Memory Load APIDs	IRD1394S004980	Each host shall have two (2) APIDs for memory loads.	Current baseline for BATC/NPP does not differentiate between ground and S/C memory load sources. This may simply be accomplished by the ground system.	Exception	[No alternate wording.]
58	3.2.6.2.1	Telemetry Maximum Bandwidth	IRD1394S005100	Hosts shall design to the maximum rate if data generation for data to be transferred via the FT1394 network so as not to lose any dat when the FT1394 data bus accepts data at their contract specified peak rates on a per second basis and allowing for network throttling per 3.2.6.2.3.1.	Current test data shows that the system, as currently setup and imposed, may not handle the traffic.	Conditional Accept Pending Testing Results	
59	3.2.6.2.3.1	Host Telemetry Buffering	IRD1394S005450	The spacecraft shall accept data from each host at its contract specified peak data rate over any one-second interval such that data available for transmission by a host is accpeted onto the 1394 bus with a delay not to exceed the following where one or more CCSDS packets of data exist in a buffer waiting for the 1394 bus to grant access for transmission:	1) This reqt, coupled with 5440, and 5460, seem to imply that some sort of buffering scheme and/or data throttling will be implemented to control the flow of data. However, no requirements are given to describe data throttling method/reqts. Are there missing requirements? 2) Similar to IRD1394S005100,current testing shows that the system, as currently setup and imposed, may not handle the traffic.	Conditional Accept Pending Testing Results	
60	3.2.6.3.3.6	Spacecraft/Ground Telecommand Authority	IRD1394S005640	Simultaneous receipt of ground terminal generated telecommands and spacecraft generated telecommands shall result in both telecommands being executed.	1) Need to understand the intent of this reqt on the spacecraft. Is the S/C required to provide this execution control mechanism or are the instruments (it appears to be a [SC] reqt, but also has a [ground] portion.) 2) NPP prioritizes commands as follows: ACBM (S/C relative time fault response commands), ground, CSM (absolute time cmds), CBM (relative time cmds). If a absolute or relative time command slides outside its execution window, it gets dropped.3) Should the applicability be [Host] rather than [SC, Ground] like 5630 above it??	Comment	
61				Figure 3.2.6-1 Segmented Mission Data and Telemetry Packet - First Segment	NOTE- BATC/NPP spacecraft does not use the number of segments field or spare fields in the secondary header. It looks like part of the data field to the spacecraft.	Comment	
62				Figure 3.2.6-8 Telecommand Segmented Data Packet - First Segment	NOTE- BATC/NPP spacecraft does not use the number of segments field or spare fields in the secondary header. It looks like part of the data field to the spacecraft.	Comment	
63	3.2.6.7.2	Bus Reconfiguration	IRD1394S200450	The Root shall activate the B bus upon detection of a failure on the A bus and diagnose the A bus.	N/A to NPP. BATC/NPP will not provide any Bus diagnostics. Can provide switch from active to inactive (A to B), but not diagnose or reconfigure. Must be provided by ground.	Exception	The NPP Network Manager shall activate the B bus upon detection of a failure on the A bus.

64	3.2.6.7.5.1	Host 1394 Initialization	IRD1394S206150	The Network Manager shall respond to a detected ring on the bus by breaking the 1394 ring using the Port Disable command and performing a Bus Reset.	NPOESS specific. N/A to NPP. BATC does not intend to use a ring like topology and therefore will not test the ability to break a ring topology.	Exception	[No alternate wording.]
65	3.2.7	UDP Ports	IRD1394S207030	The default UDP port numbers shall be as defined in Table 3.2.8-4	N/A to NPP. Need a NPP specific table.	Exception	The default UDP port numbers shall be as defined in Table 3.2.8-4B [Host]. *This table is built using the Port Rules in Table 3.2.8-1 and the Data Flow Routing Rules in Table 3.2.8-3B.*
66	3.2.8	IP Address Table	IRD1394S200580	The default IP addresses shall be as defined in Table 3.2.8-4.	N/A to NPP. Need a NPP specific table.	Exception	The default IP addresses shall be as defined in Table 3.2.8-4B [Host]. *Table 3.2.8-2B is the basic table of IP address as allocated to the various hosts, and the root as theya re used for both Bus A and Bus B*
67	3.2.8	IP Address Table	IRD1394S200585	NPOESS data routing shall be as defined in Table 3.2.8-3	N/A to NPP. Need a NPP specific table.	Exception	NPOESS data routing shall be as defined in Table 3.2.8-3B
68	3.2.8	IP Address Table		Table 3.2.8-2	N/A to NPP. Need a NPP specific table.	Exception	[See NPP/BATC provided Table 3.2.8-2B]
69	3.2.8	IP Address Table		Table 3.2.8-3	N/A to NPP. Need a NPP specific table.	Exception	[See NPP/BATC provided Table 3.2.8-3B]
70	3.2.8	IP Address Table		Table 3.2.8-4	N/A to NPP. Need a NPP specific table.	Exception	[See NPP/BATC provided Table 3.2.8-4B]
71	3.2.10	Network Fault Management	IRD1394S200600	The Network Mananger shall detect, diagnose, and correct any failure on or in the bus that impacts mission success.	NPP fault management requirements and data availablity requirements are different than NPOESS. NPP will not "diagnose" and will not "correct any failure".	Exception	[No alternate wording.]
72	3.2.10	Network Fault Management	IRD1394S200620	The Network Mananger shall detect, diagnose, and correct any single failure on or in the bus that inhibits the ability for any host to transfer data to or receive data from any other host.	NPP fault management requirements and data availablity requirements are different than NPOESS. NPP will not "diagnose" and will not "correct any failure".	Exception	[No alternate wording.]
73	3.2.10	Network Fault Management	IRD1394S200640	The Network Manager shall recover autonomously from any two faults on a single bus and with up to a single fault on the alternative bus given that the faults do not overlap common nodes where the fault may occur in any order. [NM]	NPP fault management requirements and data availablity requirements are different than NPOESS. N/A to NPP	Exception	[No alternate wording.]
74	3.2.10	Network Fault Management	IRD1394S200650	Once full performance has bee recovered subsequent to the detection of a fault, the Network Manager shall identify the fault in the non-operational bus and recover functionality of all nodes that are either directly connected or indirectly connected through a working node to the Root Node. [NM]	NPP fault management requirements and data availablity requirements are different than NPOESS. N/A to NPP	Exception	[No alternate wording.]
75	3.2.10.4	Managed Network Reconfigurations	IRD1394S200730	In the case of a Bus Reset the Network Manager shall repartition the bus to logically break the physical ring in the appropriate location to allow resumed operations.	N/A to BATC/NPP. NPOESS topology specific reqts	Exception	[No alternate wording.]

76	3.2.10.4	Managed Network Reconfigurations	IRD1394S200740	In the case where there has been more than one fault within a single bus or across the two buses in the FT1394 serial bus system, the Network Manager shall reconfigure the bus such that the faults are isolated from the serial data chain and utilize the Bus A for part of the network where the faults precluded access via the bus B and visa versa.	BATC believes that we are meeting the intent of this requirement (ie- we may be talking to CrIS on A bus and VIIRS on B bus. But the requirement wording in terms of mulitple failures and reconfiguration to isolate faults is most specific to the NPOESS ring topology and N/A to NPP	Exception	[No alternate wording.]
77	3.2.10.4	Managed Network Reconfigurations	IRD1394S200770	The spacecraft processor fault manager, upon detection of a fault in the Network/Root node combination, shall reconfigure the spacecraft processor to the alternate Network/Root-node coombination autonomously.	BATC will not autonomously switch CDPs to support 1394 activities. Under certain CDP fault conditions the S/C will swap CDPs. But this leads to the instruments being safed and power shed, the S/C going to Survival, and 1394 communications halt. The CDP swap is not a Network Manager/Root node fault detection response. N/A to NPP due to different fault management and data availability reqts.	Exception	[No alternate wording.]
78	3.2.10.4.1	Detection of Faults on Previously Suspended or Disabled Ports	IRD1394S200970	The network manager shall disable all ports not used in the system.	Why? As part of tree identify, ports that have no children are identified and not used. Why does the NM need to disable these ports as well?	Exception	[No alternate wording.]
79	3.2.11.4	Commands	IRD1394S208000		These commands are only applicable to instrument hosts. N/A to the root node/host.	Exception	[No alternate wording.]
80	3.2.11.4	Commands		Table 3.2.12-1	These commands are only applicable to instrument hosts. N/A to the root node/host.	Exception	[No alternate wording.]
81	3.3	Performance	IRD1394S007000	The FT1394 Serial Bus shall provide S100 performance per the IEEE 1394a specification when all nodes and cables are conneced as specified in this document. [SC]	This requirement also applies to [Driver]	Comment	The FT1394 Serial Bus shall provide S100 performance per the IEEE 1394a specification when all nodes and cables are conneced as specified in this document. [SC, Driver]
82	3.3.1.1	Data Rate		Table 3.3.1-1	The data rates given for VIIRS in this table are NPOESS specific and exceed the NPP contractual rates.	Exception	[See NPP/BATC provided Table 3.3.1-1B]
83	3.3.3.1	Time Code Arrival Timing	IRD1394S007130	The Time-of-Day pulse send in the TOD packet shall correspond to international standard UTC time at the occurance of the TOD pulse +/- 200 microseconds	1) Reqt probably is meant to read " The time sent in the TOD packet shall correspond to international standard UTC time at the occurance of the TOD pulse +/- 200 microseconds" 2) BATC will not meet the 200 microsecond. NPP has a 1 millisecond reqt in the SRS.	Exception	For NPP, the time sent in the TOD packet shall correspond to international standard UTC time at the occurance of the TOD pulse +/- 1 millisecond (***NASA TBR***)"
84	4	Verification	IRD1394S100000	Whole Section	1) N/A to BATC/NPP. Verification methods should not be specified to BATC. Assuming that this is "for information only". 2) You have 2 reqts labeled 1394SIRD100000 (4.1 and 4.1.1)	Exception	[No alternate wording.]